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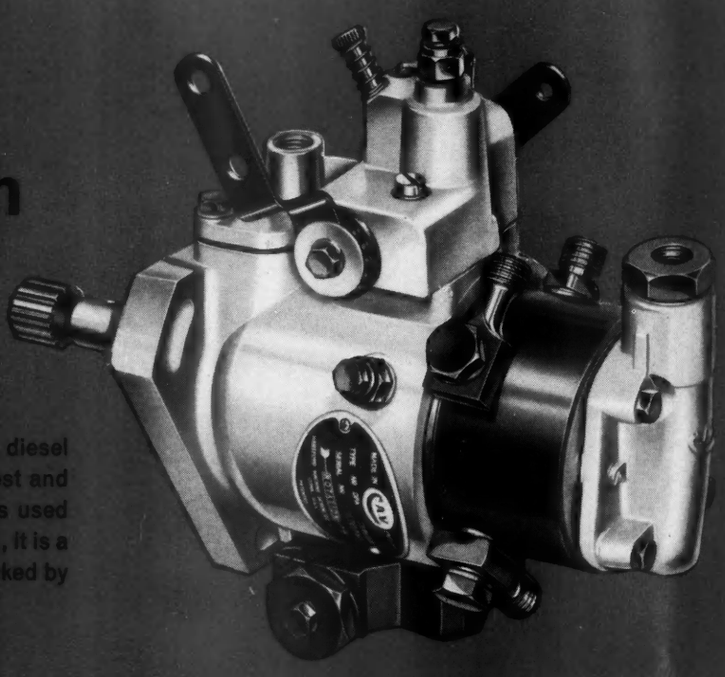

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Assembling a vane-controlled forced draught fan with aerofoil blades prior to dispatch for installation in the tanker SS "Malwa." Two fans will be fitted in this ship, each capable of delivering 37,000 cu. ft per minute against a head of 18¾ in. water gauge. (*Nurnberg photograph for* ENGINEERING)

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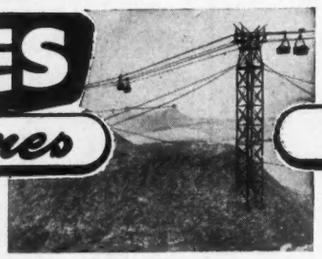

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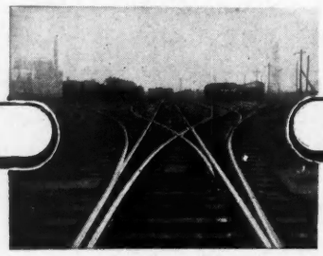

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D. H. WILLSON
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ENGINEERING Impact

of the Right Step for the Wrong Reason

THE most hopeful element in the payroll tax proposal advanced in the Budget is its vagueness. Mr. Selwyn Lloyd is seeking the power to impose the 4*s* per employee per week levy as a temporary device to be used when the occasion called for greater labour mobility.

The long gap that lies between the Chancellor of the Exchequer's first budget and final approval provides an opportunity, though it is unlikely to be taken, in which to amend the thinking behind the proposals into a form where industry will be helped and not hindered.

It is a salutary thought for the advocates of a payroll tax to see it taken up by the Treasury and used as another way of gathering in money from industry. What the Budget has failed to do is provide that, when the time comes to impose payroll tax, an equal amount to the expected revenue is removed from the national Profits Tax burden. Not to do this is to remove even more of the money industry needs for development while using the plea that the tax is more for the encouragement of labour economy than for fund raising.

There is at least another reason why the principle—every pound on payroll tax a pound off profits tax—should be fought for; not of course, firm by firm, but for all industry. As a swift deterrent to labour hoarding in a temporary difficulty, such as the motor industry's recession of a few months, 4*s* per man per week may be found to be totally ineffective.

Once given the power, the Treasury could run the tax up to the level of the employer's national insurance contribution in no time at all. The history of road taxes and income tax has only to be recalled.

Granting exemptions to the tax would be a slippery slope on which it might be disastrous to step. But if the taxpayer, private or corporate, is going to provide another £10 a year for every municipal and civil servant then the greater efficiency the tax is meant to promote will have to be imposed with real effect if serious damage by over taxation is not to be the result.

Of the sweeping surtax relief, it is no more than common sense to welcome a step which can be expected to remove a sense of grievance amongst the professional and managerial men whose effectiveness and zeal is essential for any nation's advance and prosperity.

An Intelligence Operation in Three Volumes

FOR the manufacturer of first class machine tools in Coventry and the factory owner who wants to put them to work in South Africa to be of the slightest use to each other it is necessary to know of each other's existence.

This is but one example and any one of countless others could be used to illustrate the need for information to flow before demands can be met and industrial capacity utilized. From the reception accorded to last week's launching of the new comprehensive reference directory of manufacturers and their products, Kompass Register, it is clear that the new three volume work is expected to make a substantial contribution to the ease of seeking out the appropriate United Kingdom manufacturer.

Since the directory will be widely circulated abroad, and will be one of the loosely related family of European Kompass registers. it should usefully supplement the direct efforts of manufacturers and their organizations to make themselves known. Before the finished product can be sent off to the docks there is commonly a chain of firms involved in the operation and in presenting its detailed picture of who-makes-what in Britain Kompass should be the means of smoothing out many executive worries among the 25,000 firms it is to cover.

In Switzerland, where the Kompass register began and where ten editions have so far been produced, the penetration of the work into industry is such that 85 per cent of Swiss companies are estimated to have copies on their office shelves.

Circulation on that scale in the United Kingdom would give a new flexibility to manufacturing industries. It is possible to imagine that the ease of movement that greater "intelligence" resources provide will act as a new weapon in cutting down on the number of broken delivery dates that have to be excused with references to the failure of a component manufacturer to keep to the schedule.

An Optimistic View of Export Opportunities

AN OPTIMISTIC view of British export prospects in Europe is taken by the members of the Export Council for Europe's pathfinder missions now returned from nine different countries. A full report from all nine missions will appear next month but it is known that the general impression was that the opportunities are there and if full attention is given to the special needs of each country a substantial expansion in the United Kingdom's European exports is capable of being achieved.

The countries so far visited are Austria, Denmark, France, Italy, Norway, Portugal, Spain, Sweden and Switzerland. An Export Council mission is about to return from Ireland, and next month will see missions manned by directors and managing directors going off to Holland, Western Germany, Belgium and Luxembourg, Turkey, Finland, Greece, Yugoslavia and later to Iceland.

As with the earlier teams, each of these groups will cooperate closely with United Kingdom local commercial representatives, British trading interests and existing importers of British made products. An important question that is being explored in the course of these visits is the advisability of inviting buying missions to visit Great Britain.

The 31 member Export Council for Europe, which includes representatives of industry, commerce, Government departments and the Trades Union Congress, was established last November to promote the expansion of British exports, both of goods and services, in the 19 member countries of OEEC.

of Space Research and a British Target

RESPECT and admiration for the Soviet Union's achievement in sending a manned space ship round the earth and bringing its passenger safely to earth are unqualified. The Soviet major's 108 minute ride appears as the outstanding milestone so far in the greatest engineering story of the century.

It is salutory that in the exploration of space that will follow the British part may for a long time be restricted to that of an earthbound spectator. Inter-service battles in the United States are often given as an important part of the reason for the widening distance between the American and the Russian results. If that is really the case then it is not hard to imagine the difficulties and frustrations that lie in wait for any European attempt to follow in the path of the "Vostok."

Instead, it is perhaps worthwhile to consider how much of the Soviet success has been due to a well directed singleness of purpose which has given them success after success. In the United Kingdom we have much smaller supplies of cloth from which to cut our coat, but that is no excuse for drifting along, failing to make a distinctive contribution to an exciting world.

What does Major Gagarin's "successfully completed" space flight signify to the majority of the people scratching a subsistence living from the world he circled in much less than the time that there is between one inadequate meal to the next. It can hardly help but make the Soviet Union appear all-powerful and technically unsurpassed. Giving them something to dream about it does not change their material position.

There is something here that Britain could do. We cannot find the enormous sums, reputed to run at the rate of all the United Kingdom defence spending put together, lavished on Russian space research. But the Government could choose a more limited target, say the provision of machine tools for the developing nations of the Commonwealth, or a major drive on raising the low standards of agricultural productivity pointed to by the Duke of Edinburgh in his Graham Clark lecture.

Success in such schemes, at a fraction of space research costs, would improve the lives of large numbers of people to whom we owe a responsibility, it would create work as well as dreams. If we cannot get into the "beyond" we should at least be making sacrifices and doing all that we can on this planet.

Better Industrial Fuel Efficiency

WITH the cost-price squeeze affecting industry as much this year as last the attention paid to the value industrial establishments obtain from their fuel burning plant is naturally still rising.

The requirements of the Clean Air Act have played a part in bringing the demand in the first quarter of this year for the advice and assistance of the National Industrial Fuel Efficiency Service (NIFES) to the highest level yet reached.

More than 3,250 detailed heat and power surveys have now been made in factories and commercial premises; 21 per cent more orders were placed with NIFES in the past financial year than in 1959-60. The tendency in the surveys now is towards improving the heat using processes of the factory as well as to raising efficiency in boiler house plant.

Fuel savings amount to an average of 20 per cent and in many cases have been followed by increased output and better quality. The NIFES follow through service in which engineers continue regularly visiting companies, advising on the maintenance of the best possible fuel efficiency under a regular service agreement, is used by over 900 firms.

Remedying smoke emission from boiler plant caused by shortcomings in design is sometimes a troublesome business. Further work on the plant may be necessary if the trouble is to be put right. In one case, a manufacturer of furniture, two locomotive boilers with natural draught were in use. Neither a change in the method of firing nor an increase in the supply of secondary air gave the desired effect.

The cure was found in the installation of a spring refractory arch in the firebox. This arch reflected heat radiating from the firebed on to the combustion gases released from the fresh coal, ignited them and maintained steady combustion.

Europe's Trade Rift May be Worsening

IT IS not difficult to sympathise with the view put forward by Sir William McFadzean, in his last presidential address as leader of the Federation of British Industries, that on the subject of exports, 1960 was the "Year of Exhortation." Whether 1961, as he hoped, will become the "Year of Action" remains to be seen, certainly there is a great deal to be done if the increase of 10 per cent suggested as a target by Sir William is to be reached.

Many of the most go-ahead industrial firms have invested in one country or another of the European Common Market, a necessary anticipation of the day when a United Europe replaces the hardening division between the Common Market and the British-led European Free Trade Association. The outgoing FBI chairman believes that the division between the trading blocks is solidifying; that as time goes by the attainment of unity will become more difficult.

This is a serious prospect, for the tendency has been for tariff reductions to accelerate, for the advantages to the great Common Market states, Germany, France, Italy, in trading within rather than outside their treaty area to grow impressively.

It may be that the swiftly rising standards of living in Europe will make levels of demand so high that trade between the two groups will increase whatever the tariff difficulties, a hope expressed by Sir William, but inevitably such growth would not be as fast, or perhaps as economically conducted, as if there were agreement and an all embracing free trade Europe.

Meantime there is a tendency for capital investment in EFTA and the Common Market to be to some degree duplicated, not a process likely to build up goodwill in the capital hungry emerging states of Africa, Asia and Latin America.

British Launching of Traced Pipework

Overall installation economies will probably justify using an extruded aluminium product to replace various traced pipe systems now available.

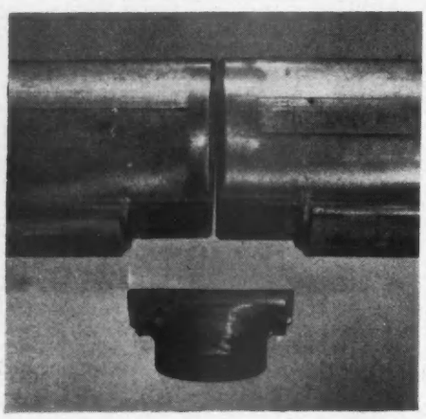
THE three large aluminium companies in this country, Alcan Industries, British Aluminium, and Impalco are stirring up interest in an extruded aluminium product which obviates the need for tracing lines. Jacketting, steam tracing or electrical heating are needed in a wide variety of industries where liquids must pass through pipes at controlled temperatures. These users defy simple grouping, but if one includes users of heavy fuel oil for industrial firing, processors of edible oils and fats, people who store and move tar and bitumen, and the chemical process industries where glacial acetic acid, ammonium nitrate and similar difficult materials are piped, one is already talking in terms of a demand in the UK for traced lines running into miles each year.

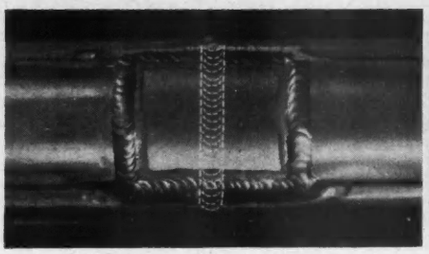
Noraltrace as it is called by Alcan Industries, Duplex pipe as named by Reynolds Metals Company in the USA (they're associated with British Aluminium), and Unitrace as it is called by Alcoa and Impalco, are all extruded aluminium pipes with an internal wall which creates a second passageway for passing steam or coolant through.

This is a simple idea, but one which will need cool analysis to show whether its use will pay in any given application. Quantity use further depends on there being available in this country a reliable supply of tube and fittings in the various sizes to specifications acceptable in British practice.

Alcoa and Reynolds Metals have been offering the pipe in America for several years and it does not appear to be a patented product. Hence Alcan, the newcomer in this field, felt justified in basing their system on the best of the American ideas. Alcan Industries have, in fact, grasped an early initiative in the UK by producing actual extrusions in three nominal bore sizes of 1¼, 2 and 3 in, and showing these together with sand cast fittings (also made in this country) at the Refrigeration and Air Conditioning Exhibition held in London last week. Impalco have also been creating interest during the past twelve months through the medium of personal contact backed up by Alcoa literature and the promise of speedy imports of all parts of this system for anyone interested. British Aluminium write that they can supply this extrusion up to 4 in nominal bore and add that they almost certainly intend using the Reynolds system of flanging which would have to be imported in the first instance.

British Aluminium comment that they hope that the advantages of this integral steam trace system are now known to all interested engineers.





This is the aluminium extrusion. Note (above) how welding can be carried out.

Whether this is so or not, the position now exists where all three companies would like to hear from potential users to judge whether the demand warrants further tooling up. Please, therefore, let the companies know if you're interested; all three will shortly be in a position to supply literature and to discuss technicalities.

All three companies seem settled on using a heat treatable aluminium alloy corresponding to HV9 specification (Alcoa and Reynolds actually use 6063 alloy which is almost identical). Proof strength is 5 tons per sq. in when solution treated in the extruded state with an elongation of 18 per cent. British Aluminium and Alcan also offer the pipe in commercial purity aluminium which is softer but has better corrosion resistance.

Economies effected by this new system may warrant acceptance of an aluminium grade in place of other metals. The pipe is immediately acceptable chemically as a replacement for independently traced aluminium pipe, but it should seldom oust stainless steel unless this has been needlessly specified. There are few instances where aluminium could not replace mild steel in chemical resistance.

The following features are part of Alcoa's specifications in America and will therefore be the basis of their system as offered in this country by Impalco. There will be seven sizes of pipe with nominal bores of 1, 1½, 2, 3, 4, 6 and 8 in. Product area to trace area varies from about 6 to 1 for the smallest to 8 to 1 for the largest size. Each is a unique section with one wall thickness for each bore. Bursting pressures allow safety factors between 20 for the smallest and about 7 for the largest when used with the maximum pressures recommended for the flanges. Nominally 150 lb per sq. in, these flange pressures vary from 137 lb per sq. in up to 75° F, reducing to 56 lb per sq. in at 400° F.

In installation, one must consider the ease of manipulation, of jointing, of insulation, of supporting, and of designing the double pipe into a thermal system. Take these in reverse order. The thermal expansion coefficient of aluminium alloys is about double that of mild steels while the modulus of elasticity is about a third. Normal pipe expansion loops can take care of the first, say Alcoa; since for any given pressure the wall thickness in aluminium is at least three times that needed in mild steels, the overall rigidity will be similar, and hence so will the frequency of supports.

Insulation poses no problem. Indeed, piping of this sort, with good heat transfer from trace line to product and a circular outer surface, can allow considerable savings—especially where extra thicknesses of insulation were used to support the temperature differential between trace and product lines needed to get heat across.

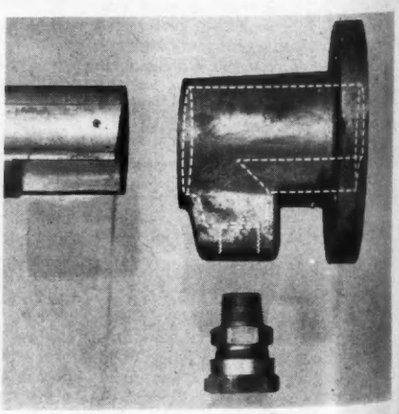
In manipulation, Alcoa Unitrace can be bent in normal equipment for aluminium pipe with the tracing section in inner, outer or side positions. Minimum centreline radii are between five and six times nominal bore diameter, but preformed elbows are sold with three times nominal bore.

For joining, Alcoa recommend welding wherever possible as this is the least expensive and the simplest method. To weld the inner wall, the outer wall must be cut back and an insert replaced after welding the inner wall. This insert can be a piece of plate, or a cast aluminium tracing cap with a boss which allows drilling for drainage plugs; steam cannot be introduced here, though, because of erosion on the inner wall. End preparation is similar when joining to a cast aluminium flange.

It is interesting that both Alcoa and Reynolds Metals in America first anticipated making flange joints with a double passage. This has been dropped by Alcoa, but is retained by Reynolds as one of their flange methods. End preparation is more complicated with the double passage, and positional accuracy is of prime importance so that the internal pipe wall is flush with the flange face after welding. Alcan comment that gasket makers in this country did not like the idea, and anticipated having to supply compressed asbestos with an aluminium envelope in order to get any strength in the internal seal.

Around this page you can see Alcan Industries' system which has been exhibited. So far, they are geared up to make 1, 1¼, 2 and 3 in nominal bore sizes. End preparation is quite simple, and the design of flange with its separate trace connection makes assembly and re-assembly very straightforward. Alcan comment that several pipework contractors have co-operated in recosting completed projects using Noraltrace, and on paper, there have been some instances where savings have been 10 to 20 per cent, while there have been others which were unfavourable. Alcan anticipate that this product will be sold direct to users and pipework contractors rather than through stockists.

Alcan Industries Limited, Banbury, Oxon.
British Aluminium Company Limited, Norfolk House, St. James's Square, London, SW1.
Imperial Aluminium Company Limited, Kynoch Works, Witton, Birmingham 6.



(*Left*) *Cast aluminium trace cap used at joint can permit fixing of drainage plugs.*

(*Right*) *Similar end preparation is used prior to welding into a single passage flange.*

Optical Glass for Aircraft

Triplex Safety Glass have jointly developed with Pilkington Brothers what they call a "new glass" for pilots' windscreens of high speed aircraft. It is an alumino-silicate glass which contains a higher percentage of aluminium oxide than normal aircraft glass.

Triplex say it can be used in temperatures between −80° C and 200° C without loss of strength. This sort of composition had been previously used in small sizes for such articles as discharge lamps for street lighting, but had never before been made to optical standards or in sizes as large as those required for aircraft panels.

It is expected by Triplex that they will have completed panels ready for use by the end of this year. In certain cases they will be gold-filmed for demisting and de-icing by electrical heating in the gold film.

Triplex Safety Glass Company Limited, Kings Norton, Birmingham.

Noble Metal Thermocouples

A third edition of *Noble Metal Thermocouples* by H. E. Bennett has been published by Johnson Matthey. The book describes the development of the noble metal thermocouple, its applications in steelworks, foundries, and glassworks, and methods of calibration. Curves of temperature against emf are given for many types of couple incorporating alloys of the platinum group metals, and a chapter describes the chief causes of deterioration in service.

A new feature of the present edition, comment Johnson Matthey, is a short section summarizing the behaviour of the many thermocouple combinations that have been proposed from time to time, and recommending those most suitable for particular applications.

Throughout process industry the accurate measurement of high temperatures is of great importance and the closer control made possible by noble metal thermocouples has contributed to numerous developments, say Johnson Matthey. The noble metal thermocouple is simple in construction, robust in use, and consistent in results.

Obtainable free from Johnson, Matthey and Company Limited, 73-78 Hatton Garden, London, EC1.

Pattern Letters

AEI Plastics (Aldridge) have extended their range of foundry pattern letters to include small sizes below ½ in. They are unusual in being made of polyethylene.

Claimed to be half the price of metal pattern letters, they have good non-stick properties and can be pinned around curved contoured patterns.

AEI Plastics (Aldridge) Limited, 33 Grosvenor Place, London, SW1.

Data Sheets on Steel Castings

The Steel Castings Development Committee is jointly sponsored by the British Steel Founders' Association and the British Steel Castings Research Association. It is essentially an information service which engineers and designers are invited to make use of. One of the first projects of this committee has been to put in hand the preparation of data sheets on steel castings, the first five of which are now available.

The data provided are complementary to those given in British Standards and other nationally recognised specifications (which have already been summarised by BSCRA in their publication *British and Foreign Specifications for Steel Castings*). They are prepared from data provided by BSCRA based on their own investigations or upon other reliable sources. You can get an idea of their scope from the following titles, the numbers being those of each data sheet. (1) Low temperature properties of plain carbon steel castings. (2) Low temperature properties of pearlitic manganese steel castings. (3) Low temperature properties of low and medium alloy steel castings. (4) Magnetic properties of plain carbon steel castings. (5) Fatigue properties of steel castings.

Obtainable free from Steel Castings Development Committee, British Steel Founders' Association, 13 Broomgrove Road, Sheffield 10.

Cold-Store Insulation with Expanded Pvc

Plasticell is the name given by Microcell Limited to their expanded pvc material. In texture this is similar to the product made from polystyrene beads—it consists of a large number of expanded spheres joined together into a solid block. This structure gives it quite good rigidity and strength for its density of 2½ to 6¼ lb per cu. ft.

Microcell say it has an extremely wide application in the refrigeration, air-conditioning and allied industries, and they displayed several uses of the material at the last week's International Refrigeration and Air Conditioning Exhibition. This illustration shows how it is being built into cold storage conservators at the plant of T. Wall and Sons at Park Royal. You can see that the 20 cu. ft containers have interlayers of Plasticell for insulation.

Microcell Limited, Ingersoll House, 9 Kingsway, London, WC2.

More Silicones—and Cold-Curing Rubbers

In the sphere of silicones—which includes resins, fluids and rubbers—sizeable developments are taking place. More than half a million pounds worth of new plant is coming into operation during this month at the Midland Silicones factory at Barry, South Wales. At the same time work is already in hand on additional production equipment representing a further investment of the same order.

The new installations of Midland Silicones which are just starting production include a plant for manufacturing methyl chloride, one of the prime raw materials for silicone production; a new direct process unit for production of chlorosilanes, which will nearly double previously existing capacity; and a new silicone fluids production unit with more than twice the capacity of the equipment at present in use.

One of the products made by this firm—cold-curing silicone rubber—is claimed to be having mounting sales, so that with manufacturing economies the price has now been brought down about 5 per cent as from February. This is still an expensive product with a price of about £1 a lb, but it's encouraging to see the price begin to drop. (See ENGNG., 18 Nov. '60, p. 670, for an article showing how this rubber is being used.)

In America, International General Electric (who are connected with ICI over cold-curing rubbers) say they can now offer the fluid grade of these materials in the form of two aerosol canisters. The one can contains the uncured rubber, and the other the curing agent. Cure time is said to range from 15 minutes to several hours after spraying the first coat of uncured rubber with a second coat of curing agent. General Electric do not say in their release whether this time variation is due to the virtually uncontrollable proportions of the two parts when applied in this manner. They expect it to be useful for applying encapsulating coatings on electronic assemblies and parts, and as a release agent for moulded plastics, among other uses.

The International General Electric aerosol rubber is designated RTV-60 and is red in colour (as are present ICI grades). They expect to market a white cold-curing compound as well, like the Dow Corning and Midland Silicones varieties.

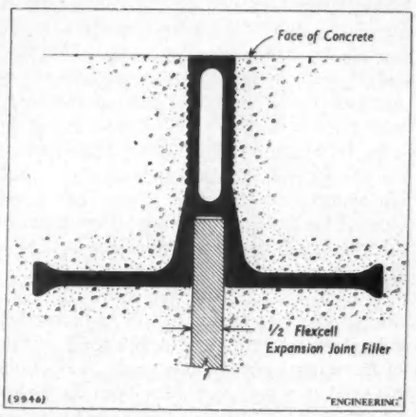
Midland Silicones Limited, 68 Knightsbridge, London, SW1.

International General Electric Company, Inc., 570 Lexington Avenue, New York 27, New York, USA.

Joint Filler and Pvc Waterstop

Expandite are now offering two products for making watertight joints in concrete. The second of these will withstand buffeting such as experienced in seawalls.

Hydrocor is a granulated cork material bound with a resin which is insoluble in hydrochloric acid. It comes in long strips with rectangular section and has the useful property of expanding on contact with water. This complies with US Federal Specification HH-F-341a "Filler, Expansion Joint, Preformed, Non-extruding and Resilient Types (for Concrete)," and is classified as Type II—Self-expanding. Thus it is compressed to 50 per cent of its original thickness by a load not exceeding 1,500 lb per sq. in, and it will recover to at least 90 per cent of its original thickness when the compression load is released. Hydrocor is available in ½, ¾ and 1 in thicknesses, in lengths up to 5 ft and widths up to 18 in.



Illustrated here is a section through the new waterstop intended for expansion joints in concrete seawalls, for other applications such as culverts, and where it is desirable not to have a sealing compound which can be displaced in service. The black portion is the new extrusion shape, based on the Expandite Hydrofoil profile which is described as well-tried. Note that it now has a hollow portion at right angles to and in front of the waterstop to fill the cavity between adjacent pours of concrete. The grade of pvc used by Expandite has a tensile strength of at least 2,000 lb per sq. in initially with an elongation at break of 250 per cent minimum, a BS hardness of 42 to 52, water absorption of 2·5 to 3·0 per cent, and a cold crack temperature (presumably before ageing) not higher than − 25° C.

Expandite Limited, Chase Road, London, NW10.

Plain Words

By Capricorn

MOST of us are title-seekers these days. We may not know it, but with our desire to be appointed manager, deputy manager, section chief or company director, we reinforce the old class barriers by which our society is bedevilled—or set up new ones. We may pretend we want increased responsibility, but what our spirits crave is honour and prestige—and higher wages. And eventually, before Tom in Christ Church tower strikes three times, we have young undergraduates deny their humble parents.

The urge for distinction in this age of the Common Man takes many forms. Engineers are touchy for example on the definition of an "engineer" and suspect a conspiracy of general usage, aided and abetted by the popular Press, to give the word a wider currency. In that engineering operatives are also known as engineers, qualified engineers are left looking rather stuffy when they protest their professional distinction from members of the AEU.

All this is part of a wider social phenomenon. It's a new kind of caucus race. Everyone works and everyone must have a title. Time was when our grandfathers laughed at the Russians because all petty officials aspired to wear a peaked cap. In our own day we have sniggered at the Swedes when their local papers have announced that "locomotive fireman" so-and-so has married the village belle. Germans have often raised a smile by referring to the Herr Direktor, and they recently increased recruitment of dustmen by inventing a distinguished and impressive sounding title. Good for them.

In this country the tide is also coming in. Nearly all newspapers today give their top men bylines. Trades which demand no more than a trained aptitude offer elaborate titles and you can get a diploma for nearly anything.

The hallmark of the new distinction is a title, if possible with an aura of respectability. And it need not be a title to nobility. One of the most recent of these and one with all the necessary ingredients has been the formation of an Association of Peacekeepers, which would have been known at one time by the homely and more descriptive title of trade union for chuckers-out. Both trade and union surely deserve a more agressive appelation. This organization, which operates in the West of London has a scale of fees (not charges or wages) and emphasises not only the business-like way in which associates operate but also that they act in a seemly almost genteel manner in the process of showing the offensive person to the door. The unwanted are ejected with decorum. The paid bruiser is out; the organization man is in.

In case some of these associates should consider my remarks worthy of some genteel action on their part I hasten to say that I am definitely on their side. Journalism has sometimes been regarded as a craft; it is of course, like theirs, an honourable profession.

Letters to the Editor

Standardization in Engineering Plant Design

SIR, We have been very interested in your article entitled "What Users Want from Engineering Plant" (ENGNG., 14 April, '61, p. 522.)

This Association has as its main objects the formulation and promotion of a common policy for the standardization of engineering material, equipment and consumable stores and the promotion through the British Standards Institution or otherwise of the preparation and adoption of specifications for such materials, equipment or stores appropriate to users' requirements. We have, therefore, among other things, promoted the standardization of ranges and fixing or envelope dimensions of plant, such as electric motors and reduction gears, and would like to see this work extended to many of the items of plant which you have listed, so that the products of different manufacturers may be interchangeable. This is possible without placing undue restrictions on the internal features.

We have always stressed the real need in industry for a much greater degree of this kind of standardization. Over the last decade a good deal of progress has been made and resulting from our pioneer work we now have dimensional standards for ranges of electric motor, worm-gear reduction units, etc., thanks to the cooperation of the manufacturing associations concerned.

A good deal of dimensional standardization is going forward in the British Standards Institution now. We are, for example, very pleased that the BSI are actually drafting dimensional standards for ranges of split casing and end suction centrifugal pumps based on this Association's proposals.

All that has been achieved, however, is a beginning only and publicity and continued drive is needed to achieve that high level of dimensional standardization of commonly used items of material and equipment which industry needs if high productive efficiency is to be maintained.

There is also the field of practice standardization which we think vitally important and in which we do a great deal of work on a variety of subjects. It is, of course, impossible to separate equipment standardization from practice standardization and the two must always go hand in hand.

We realise that such tasks require a high degree of collaboration between the manufacturers and between them and the users and know how difficult it is to get work of this nature moving. If you can, therefore, through your survey, succeed in initiating action in this direction, it will help the user for the purpose of interchangeability and the reduction of idle plant, and the manufacturer in allowing him to arrange his production for maximum efficiency, providing a range of products which may be attractive to the home and export market.

Yours sincerely
H. DE J. KEAYS,
General Secretary.

Engineering Equipment Users Association,
London, SW1.
14 April, 1961.

Designer and Writer

SIR, I have met the same circumstances reported by Mr. Taylor (ENGNG., 7 Apr. '61, p. 476) in revising instruction manuals and in editing technical reports. How do the shortcomings arise? There is ample written "instruction" available for those interested, all classes can do more to focus interest on it. You do not learn mathematics by reading about it or by attending classes in it, but by practice; so with writing, intensive practice over the years. But classes tend to make it a required accomplishment and thereby introduce the incentive.

Formulae make no sense if they break the rules, neither do sentences. Grammar sets out the rules, ensures a single meaning to the reader, but style is learned from the classics of English writing. When assimilated, the classics will influence good style, they show the scope of application of the rules. There are also techniques; psychological appreciation is involved. How is the reader's mind to follow you, how large the steps, have any rungs been missed? On matters of technique there are many good guides, among which: *The Presentation of Technical Information*, R. O. Kapp (Constable), *Technical Literature*, G. E. Williams (G. Allen & Unwin), *The Complete Plain Words*, Sir E. Gowers (HMSO), *Communication in the Field of Science*, R. H. Macmillan (Penguin Science News 49), and the gist of report writing in a nutshell, that excellent check list and hint giver, *Report Writing* (Department of Industrial Administration, College of Technology, Birmingham). For the general, to be read before the technical, that little gem *On the Writing of English*, G. T. Warner (Blackie).

The technical writer unfamiliar with English literature does not realise the damage worked by Dr. Johnson and the Grammar School in their over-respect for Latin. Consider the Bible, written by Latin scholars, writing for everyman, a model of simple clarity, much more Anglo-Saxon than Latin.

Within an organization, the report writer will work with the "editing standards" in mind, which Mr. Williams calls "The Style of the House"; will know and use the library of information concerning terms, symbols, standards, and acknowledged references to which it is an index.

A test of progress is writing for publication; ragged work is not paid for. Self-training, self-criticism against good standards make the good writer, so he must analyse what good writers do and what bad ones fail to do.

Your faithfully,
W. D. ARNOT.

Nuneaton,
Warwickshire.
15 April, 1961.

Events in Advance

Britain Gives a Lead in Timber Engineering

PLANS are now well advanced respecting the holding of the First International Conference on Timber Engineering, which is due to take place at the University of Southampton from 18 to 23 September next. The event is being organized jointly by the University and the Timber Development Association.

In addition to the very substantial support promised by individuals and organisations in Britain, delegates will be attending the conference from a number of overseas countries, including Australia, Austria, Czechoslovakia, France, Holland, India, Norway, Poland, Russia and the United States. Time will be devoted during the conference to visiting sites.

Papers for the conference will be presented under four main headings: description, construction, design and research; and will include contributions on the economics of timber roofing, international developments in the design and construction of timber shells and folded plates, and methods of jointing and testing of timber roof structures.

Contributions which may be mentioned separately include "Shell Roofs in Brussels and Holland," by J. H. Pestman of Holland; "The Design, Testing and Construction of a Timber Conoid Shell Roof," by Dr. L. G. Booth of Southampton University; and "The Application of Research to the Design of Timber Roof Structures," by D. W. Cooper of the University of Durham.

Requests for additional information should preferably be addressed to the secretary of the

conference: Dr. H. G. Allen, Department of Civil Engineering, The University, Southampton. The offices of the Timber Development Association are at 21 College Hill, London, EC4. (Telephone: CITy 4771)

New Interest in Plastering

WITH the object of bringing the latest developments in plastering practice to the notice of architects, general contractors, the building industry and government departments, a one-day conference has been organized by the National Federation of Plastering Contractors, and will have as its theme " Developments in Plastering."

Subjects to be discussed will include the mechanization of plastering operations, fire protection by plastering, and the place of plastering in modern buildings. The conference fee, inclusive of luncheon, will be two guineas a head.

The event will be held at the Connaught Rooms, Great Queen Street, London, WC2, on 20 June next. Applications for tickets, or additional information, should be addressed to the secretary, the National Federation of Plastering Contractors, 82 New Cavendish Street, London, W1 (telephone: LANgham 4041) and should be submitted promptly.

Management Aspects of Engineering Inspection

FUNCTIONS of management in relation to engineering inspection, the economics of inspection, and the non-destructive testing of materials of all descriptions, are among the subjects to be discussed at a conference which is being arranged at Oxford during the four days 5 to 8 September next. Attention will also be directed to such matters as the recruitment, education and training of inspection staffs.

The conference has been planned at the request of the Joint Committee of Materials and their Testing and of the British National Committee for Non-Destructive Testing. It is being organized jointly by the Institution of Engineering Inspection and the Society of Non-Destructive Examination. Authors being invited to present papers at the conference have all had wide experience in their particular fields, and ample time is being allotted to discussions.

Residential accommodation has been reserved for delegates at Queen's College and New College, Oxford. The total cost of attendance, including the conference fee, accommodation in college and all meals, will amount to £9 10s per delegate.

Programmes and further details are expected to be available shorly. All communications should be sent to the secretary, the Institution of Engineering Inspection, 616 Grand Buildings, Trafalgar Square, London, WC2. (Telephone: WHItehall 0818)

Exhibitions and Conferences

Sewage Purification, Institute of.—Annual Conference: Mon., 19 June, to Fri., 23 June, at Brighton. Conference will mark the 60th anniversay of the founding of the Institute. Offices of the Institute: 10 Cromwell Place, South Kensington, London, SW7. Tel. KENsington 3885.

Light Metals, Fourth International Conference on.—Tues., 20 June, to Sat., 24 June, at Leoben. Theme: " Light Metals in Light Construction, in Architecture and in Special Fields." Organized by the Montanistische Hochschule, Leoben, and the Austrian light metal industry. Apply to the secretary, Internationalen Leichtmetalltagung, Montanistische Hochschule, Leoben/Stmk., Austria.

Transmission and Processing of Information, International Symposium.—Wed., 6 Sept., to Fri., 8 Sept., at Cambridge, Mass., USA. Sponsored by the Professional Group on Information Theory of the Institute of Radio Engineers, in cooperation with the Research Laboratory of Electronics of the Massachusetts Institute of Technology. Apply to Mr. R. M. Fano, Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge 39, Mass., USA.

Documentation, International Federation for.—Annual Conference: Wed., 6 Sept., to Sat., 16 Sept., at Caxton Hall, off Victoria Street, London, SW1 Organised at the invitation of Aslib. Apply to the secretary, Aslib, 3 Belgrave Square, London, SW1. Tel. BELgravia 5050.

Ship Structures Congress, International.—First meeting, Tues., 19 Sept., to Thurs., 21 Sept., at Glasgow University. Apply to Professor J. F. C. Conn, Department of Naval Architecture, The University, Glasgow, W2. Tel. Kelvin 2231.

British Equipment for Mexican Industry: Fair.—Fri., 29 Sept., to Sun., 15 Oct., in Mexico City. Sponsored jointly by the Dollar Exports Council and the Federation of British Industries. Apply to British Overseas Trade Fairs, Ltd., 21 Tothill Street, London, SW1. Tel. WHItehall 6711.

Effluent and Water Treatment Exhibition and Convention.—Tues., 31 Oct., to Fri., 3 Nov., at the Seymour Hall, Seymour Place, London, W1. Organizers: Thunderbird Enterprises Ltd., 140 Cromwell Road, South Kensington, London, SW7. Tel. FREmantle 4063.

British Equipment for Mexican Development: Fair.—Fri., 3 Nov., to Sun., 19 Nov., in Mexico City. Sponsored jointly by the Dollar Exports Council and the Federation of British Industries. Apply to British Overseas Trade Fairs Ltd., 21 Tothill Street, London, SW1. Tel. WHItehall 6711.

Maintenance Conference and Exhibition, National.—Mon., 13 Nov., to Thurs., 16 Nov., at the Central Hall, Westminster, London, SW1. Organized by *Plant and Factory Maintenance*, Mercury House, 109-119 Waterloo Road, London, SE1. Tel. WATerloo 3388.

Factory Equipment, Heating, Ventilation and Thermal Insulation Exhibition.—Mon., 13 Nov., to Sat., 18 Nov., at Earls Court, London, SW5. Organized by Industrial and Trade Fairs Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Building Exhibition, 29th.—Wed., 15 Nov., to Wed., 29 Nov., at Olympia, London, W14. Organized by the Building Trades Exhibition Ltd., 11 Manchester Square, London, W1. Tel. HUNter 1951.

Engineering, Scientific and Technical Film Festival, Second International.—Thurs., 16 Nov., to Sat., 25 Nov., in Budapest, Hungary. This festival will coincide with a conference of the popular scientific section of the International Scientific Film Association. In the United Kingdom, further information may be obtained from Hungarian News and Information Service, 167 Kensington High Street, London, W8 (Tel. WEStern 9561); and the Scientific Film Association, 3 Belgrave Square, London, SW1. Tel. BELgravia 6188.

Design of Equipment for Human Use, Course on.—Mon., 20 Nov., to Fri., 1 Dec., at Engineers' House, Bristol 8. Organised by the Engineering and Allied Employers' West of England Association, Engineers' House, The Promenade, Clifton Down, Bristol 8. Tel. Bristol 3-9131.

Display Production and Screen Printing Exhibition and Product Fair.—Mon., 27 Nov., to Fri., 1 Dec., at Washington Hotel, Curzon Street, London, W1. Organized by the Display Producers and Screen Printers Association, 28 Ely Place, Holborn Circus, London, EC1. Tel. HOLborn 1746.

Programming of Research Reactors, Symposium.—In December, in Vienna. Apply to the International Atomic Energy Agency, Kaerntnerring, Vienna 1, Austria. (*This event may be brought forward to October.*)

Production Exhibition, Fifth.—Mon., 30 April, to Sat., 5 May, 1962, at Olympia, London, W14. Organised by Andrey Montgomery Ltd., 11 Manchester Square, London, W1. Tel. HUNter 1951.

Meetings and Papers

British Institution of Radio Engineers

LONDON
" Computer Control of Air Traffic ": symposium, comprising " General Problems of Air-Traffic Control," by E. W. Pike; " Input Requirements for Data-Processing Complex," by Dr. L. G. Payne; " An Experimental Data-Processing Complex," by A. St. Johnston; " The Output Display of Data from the Data-Processing Complex," by K. H. Simpkin; " Real Time Inputs and Dynamic Display for Data-Processing Systems," by R. F. Hansford; and " Design Principles of Computers for Air-Traffic Control," by H. Scholten. Joint meeting of the Computer and Radar Groups. University College, Gower Street, WC1. Wed., 3 May, 3 p.m. (Revised details).

Institute of Physics and the Physical Society; and the Royal Institution

LONDON
" A Hundred Years of Colour Photography," by Dr. D. A. Spencer. Organised by the Colour Group, in collaboration with the Institute of Physics and the Physical Society, to mark the centenary of James Clark Maxwell's demonstration of trichromatic colour reproduction at the Royal Institution on 17 May, 1861. At the Royal Institution, Albemarle Street W1. Wed., 17 May, 9 p.m.

Institute of Road Transport Engineers

CARDIFF
" History and Development of High-Octane Motor Spirit," by J. C. Street. South Wales Centre. South Wales Institute of Engineers, Park Place, Cardiff. Fri., 12 May, 7.15 p.m.

Institution of Civil Engineers

LONDON
" Collaboration Between Engineers and Landscape Architects," by C. S. Chettoe and G. A. Jellicoe. Joint Meeting with the Institute of Landscape Architects. Thurs., 11 May, 5.40 p.m.*

Institution of Electrical Engineers

LONDON
" Electricity Supply in India and Its Future," by Dr. M. Datta. Annual Lecture. Supply Section. Wed., 10 May, 5.30 p.m.*
" The Place of Transistors in National Certificate Courses ": to be opened by B. F. Gray and W. B. K. Ellis. Education Discussion Circle. Fri., 12 May, 6 p.m.*
" The Experimental Investigation of Space," Annual Graduates' and Students' Lecture, by Dr. P. J. Bowen. Preceded by the Annual General Meeting. London Graduate and Student Section. Mon., 15 May, 6.30 p.m.*

MANCHESTER
" The Protection of High-Voltage Systems from Lightning Faults," by Dr. R. H. Golde. Annual General Meeting. North Western Centre. Engineers' Club, Albert Square, Manchester. Tues., 9 May, 6.15 p.m.

Institution of Electronics

BIRMINGHAM
" Tunnel Diode Circuit Applications," by I. Aleksander. Birmingham Branch. The New College of Technology, Gosta Green, Birmingham 4. Thurs., 18 May, 7 p.m.

Institution of Locomotive Engineers

LONDON
The Sir Seymour Biscoe Tritton Lecture, by Sir Brian Robertson, Bt. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Fri., 12 May, 5.30 p.m.*

Institution of Plant Engineers

BLACKBURN
" Electronics," by J. Siddon. Blackburn Branch. Castle Hotel, Blackburn. Thurs., 18 May, 7.30 p.m.

GLASGOW
" Glasgow Water Supply ": Discussion. Glasgow Branch. Scottish Building Centre, 425 Sauchiehall Street, Glasgow, C2. Thurs., 11 May, 7.15 p.m.

NEWCASTLE UPON TYNE
" Cigarette-Manufacturing Processes," by A. C. Lane. North East Branch. Roadway House, Oxford Street, Newcastle upon Tyne. Thurs., 11 May, 7 p.m.

ROCHESTER
" Electrical Regulations and Precautions," by G. T. Fisher. Kent Branch. King's Head Hotel, High Street, Rochester. Wed., 17 May, 7 p.m.

Institution of Production Engineers

DROITWICH
" Production Development ": one-day conference. Midlands Region. Winter Gardens and the Raven Hotel, Droitwich. Wed., 10 May, 9.30 a.m. (Apply for tickets to the regional secretary, Mr. A. C. Turner, Waverley, Church Lane, Whittington, Worcester.)

Royal Aeronautical Society

LONDON
General Discussion Evening. Historical Group. Mon., 8 May, 7 p.m.
" Structural Weight Estimations for Novel Configurations," by M. E. Burt. Tues., 9 May, 7 p.m.

Royal Society of Arts

LONDON
" The Future Pattern of University Education in the United Kingdom," by J. S. Fulton. Wed., 10 May, 6 p.m.

Society of Instrument Technology

LONDON
Annual General Meeting, at 6.15 p.m. " Control Mechanisms in the Human Nervous System," by Dr. W. Grey Walter, at 7 p.m. Control Section. Manson House, 25 Portland Place, W1. Thurs., 11 May, 7 p.m.*

MANCHESTER
" The Thermocouple ": chairman's address, by Dr. A. W. Foster. Manchester Section. Nag's Head, Jackson's Row, Manchester. Mon., 15 May, 6.45 p.m.

NEWCASTLE UPON TYNE
Annual General Meeting. Newcastle Section. Roadway House, Oxford Street, Newcastle upon Tyne 1. Thurs., 18 May, 7 p.m.

South Wales Institute of Engineers

CARDIFF
" Cable Belts Underground in Coal mines," by Lister Walker and A. E. Hiscox. Thurs., 18 May, 6 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

British Institution of Radio Engineers, 9 Bedford Square' London, WC1. (MUSeum 1901)
Institute of Physics and the Physical Society, 47 Belgrave Square, London, SW1. (BELgravia 6111)
Institute of Road Transport Engineers, 1 Cromwell Place, South Kensington, London, SW7. (KENsington 3744)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Electronics, 78 Shaw Road, Thornham, Rochdale, Lancs. (Oldham Main 6661)
Institution of Locomotive Engineers, 28 Victoria Street, London, SW1. (ABBey 6672)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Royal Aeronautical Society, 4 Hamilton Place, London, W1. (GROsvenor 3515)
Royal Institution, 21 Albemarle Street, London, W1. (HYDe Park 0669)
Royal Society of Arts, John Adam Street, Adelphi, London, WC2. (TRAfalgar 2366)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)
South Wales Institute of Engineers, Park Place, Cardiff. (Cardiff 23296)

Industrial Design Moves Into Engineering

The industrial designer is playing an increasing part in capital goods design, and the Council of Industrial Design's Record of Designers now handles inquiries from a wide variety of capital goods concerns who wish to improve design standards.

By W. H. Mayall

Officer for Engineering, Council of Industrial Design

THERE are now about three times as many industrial designers working on capital equipment, from electronic and electric equipment to instruments and machine tools, as there were three years ago. In view of this development, it is worth while considering in broad terms how the industrial designer came about and what he has to offer particularly in relation to capital plant and equipment.

GROWTH IN CAPITAL GOODS

While there are several pre-war examples of industrial design work on capital goods, mainly of American origin, it did not become really noticeable until the early part of the nineteen-fifties. At this time the output was again mainly American with sporadic contributions from British and Continental sources. Such work was frequently greeted with suspicion and often with open derision. "Styling," it was said, might be tolerated on domestic products but not on manufacturing equipment. In addition the industrial designer's connections with that airy-fairy subject "Art" did not appeal to the more pragmatic engineer. Moreover there was the reaction coming from a feeling which anyone who has ever designed anything can understand: the feeling of ownership which goes with one's creation and which makes one want to fend off intruders who threaten to interfere with it.

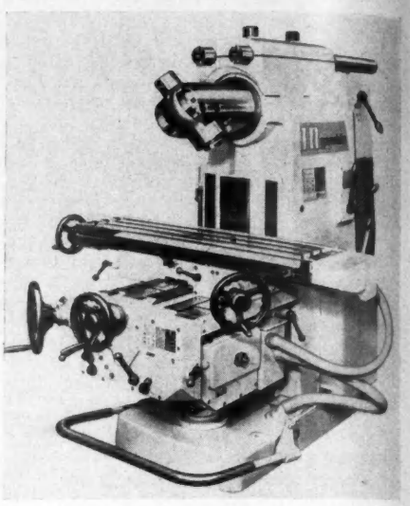
It would be pointless to deny that these attitudes do not exist today. However, there are signs that they are receding; possibly there are two principal reasons for this. One is that engineering design work is becoming much more a matter of team work, where the team is composed of specialists, each contributing his expertise, rather than a matter of one leading designer producing the whole design and administering the work with the aid of junior staff. As a result of this change, the engineering design leader today may be valued not only for his ability to provide the initial design impetus but also for the skill with which he can pick and organize his team of specialists. Such a man is therefore much more ready to bring in the industrial designer as a specialist to help him and he will review this action in terms of design costing rather than in those terms mentioned.

The other reason for a changing attitude to industrial design is clearly the increasingly competitive nature of capital goods selling. While technical improvement, lower prices and efficient servicing facilities are paramount sales factors, there is no doubt that buyers react favourably or unfavourably to a machine's appearance. Competition has brought a number of manufacturers, who either have not developed specialist teams or may never need to do so, to employ consultant industrial designers to meet rising standards of "appearance."

The illustrations show that industrial design work on capital equipment is by no means confined to this country. In fact, too frequently one hears comment that British machine appearance has not climbed out of the nineteenth century. Criticism is easily overstated, and we are not that far behind. However British traditional engineering qualities are not necessarily dependent on traditional design forms and manufacturers who have appreciated this point have called upon industrial designers to help them raise their standards.

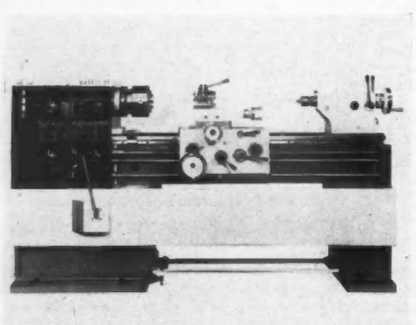
ORIGINS AND AIMS

Changes in the engineering design process and increased competition have, of course, grown out of the rapid advance of technology as a whole. The industrial designer himself is a product of this swift technological progress. Indeed engineering was responsible for the industrial designer's birth. By producing the means to make goods in quantity and at lower cost, and by providing us with wholly new devices in our homes and elsewhere, engineering completely and irrevocably changed the pattern of society. We are still adjusting ourselves to this sweeping change and this process of adjustment runs through most of our activities. The industrial designer emerged as an "adjuster." On the

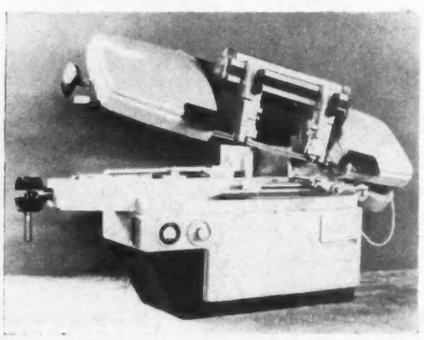


Few modern milling machines have the same clarity of layout as this Gambin 1N machine from France. It was designed in conjunction with an industrial design consultant in 1952, when industrial design first began to develop in engineering.

Recent industrial design work on capital equipment abroad is shown in these illustrations.



(Extreme left) Gallic 16 centre lathe. Mondiale —Belgium.

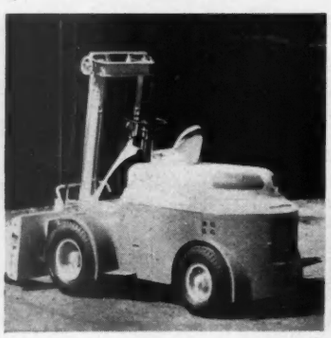


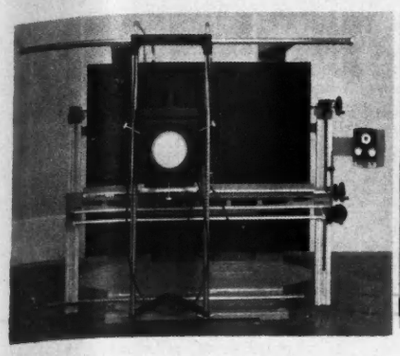
(Left) Bandsaw. Sugimoto—Japan.

Mobile crane. Hyster —USA. Before (right) and after (below).

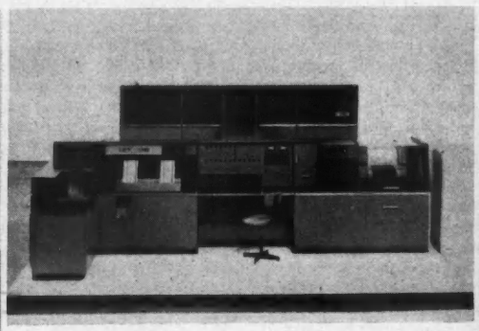
(Below) Router. Onsrud—USA.

(Below) Fork lift truck. Salev—France. Before (left) and after (right).



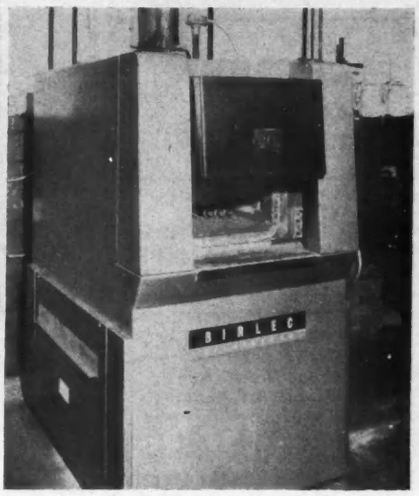


Step and repeat machine. Pictorial Machinery Limited. (Monotype Corporation).



Computer. Computers and Tabulators Limited.

These British machines and equipment illustrate the variety of work being undertaken at home by calling in the consultant industrial designer for advice in re-design.



Electric furnace. AEI Birlec Limited.

one hand we had to be persuaded that new ways of living brought about by new processes and devices meant the acceptance of new design forms; on the other hand someone was needed to make these forms suitable and appealing to us.

While neither of these tasks has been anywhere near accomplished, most of us now accept in some measure new concepts of form in the things we buy if only because many of these goods have no historical relations. Admittedly disguises are attempted and one can still buy electric heaters masquerading as coal fires but many modern goods simply defy disguise. Broadly speaking, therefore, impelled by modern living conditions we have moved towards an acceptance of new design forms.

Consequently today the industrial designer is becoming less concerned with persuading people to accept new concepts and more concerned with making products appropriate to human use; appropriate not only to the action of use, but to the environmental circumstances of modern life. It is this aim which forms the basis of the industrial designer's work on capital goods.

AIM IN CAPITAL GOODS

Some of the early industrial design work on machinery only showed a concern for modernising forms, as if to bring them in line with new forms in consumer products. It was as if the industrial designer was sometimes concerned rather more with introducing these new concepts than with designing to suit human use. Sometimes he incorporated "contemporary" design clichés and on a few occasions his forms contradicted basic mechanical functions instead of contributing to them. Examples of this kind of approach are still being produced, but oddly enough more by the engineering designer than the industrial designer.

While avoiding styling tricks, developing a machine's appearance to suit modern circumstances is certainly a valid objective. Indeed, it is an essential one. A manufacturer is more likely to buy a machine which looks up to date, all else being equal, especially if he is installing it in a modern factory. Plant and equipment makers have used industrial designers solely for this purpose and there may be occasions when this is the only purpose that the industrial designer can fulfil. Designing to suit modern environments not only relates to, say, the factory structure, but also of course, to modern working conditions and the changing attitudes concerning people at work.

Appearance on productive equipment especially has however a more definite part to play. Form, texture and colour can be used to simplify the complex machine. They can help to define working regions. Selecting finishes which do not absorb light excessively or produce glare; laying out and identifying controls for quick and accurate use are but two examples of what might be called "putting aesthetics to work."

This more positive view of machine appearance should be the first to be considered when examining industrial design work. While it may depend in part upon the industrial designer's particular perceptive abilities, it also depends upon his applying the findings of ergonomic or human engineering work. Visual indicator design, control panel layout and colour selection for working areas are examples of fields where ergonomic investigation and data have been useful to the industrial designer. In addition, ergonomics also help the industrial designer to incorporate proper work heights and reaches. AEI (Manchester), one of the few capital goods companies to have an industrial design section, includes therefore an ergonomics laboratory to aid this type of work.

While the industrial designer is not appropriating ergonomics as his own subject—it is equally important to the engineer—ergonomics does come within his broad aim of designing equipment to suit the people using it. This aim is worth a little speculation with regard to future development.

TRAINING FOR DESIGN

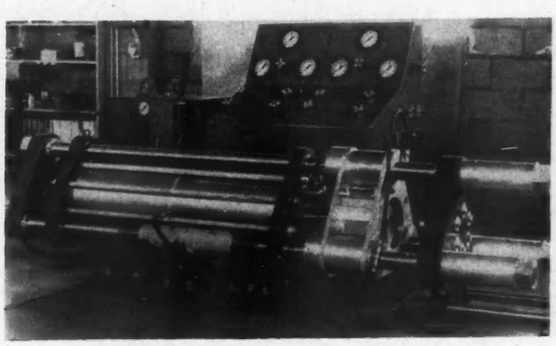
It would be wrong to suggest that this broad aim is not also that of the engineering designer. Obviously he wishes to make his products both useful and usable. However, the greater specialisation needed to achieve these complementary aims today is drawing a distinction between the industrial and engineering designer. Clearly both types of designer may be concerned with similar matters and one cannot make sharp distinctions. Both designers work within frameworks of manufacturing processes, costs and delivery targets; and improvements in respect of these factors are just as important to the industrial designer as to the engineering designer.

Speculation arises from whether the distinction will in fact become more sharply defined in the future. To some extent, what may be happening now can be compared with the separation of architecture and building in an earlier period. Since a prime aim in present day engineering is the maintenance of technical development, and since we are desperately in need of more engineers to fulfil this purpose, it would seem that engineers will be less and less able to accomplish tasks coming within the industrial designer's broad aim. Though the industrial designer was referred to as a specialist, his value, unlike most specialists, lies very much in his having an understanding of design in other fields and with keeping his fingers on the pulse of social change. Present day engineering training severely limits these aspects and though we may wish to broaden the engineer's outlook, we simply may not have the time to do so.

Such points may be argued over and perhaps there are ways of improving engineering design training to produce broader outlooks while developing technical expertise. But one thing is certain: technical innovation and development are vital and must be pursued by all available means. Whatever happens to engineering in the future, its development will be dictated by this prime purpose. We cannot avoid specialisation, and it is in this light that we have to look at what the industrial designer has to offer.

Maybe the engineering designer could "do it himself," if given a new form of training. The CoID believes that he should understand the factors involved in industrial design work and has set up short residential courses for engineers precisely for this purpose. However, world competition today requires action as well as understanding and that is why the CoID is currently advertising its Record of Designers which will help manufacturers to find industrial designers either for staff or consultancy work in engineering.

It should be added that the CoID is always ready to discuss the potentialities of industrial design work on engineering projects before formal applications are made to this particular department—the time to do this is at the start of a project; the best condition is when technical improvements are being made.



The time to call in the industrial designer is when technical development is being made and at the beginning of a job. These points are underlined by this illustration of industrial design work on Convair's Dynapak machine which employs new principles for pressure forming components.

Human Element

Engineering and the Future Commonwealth

SETTING the target for the Commonwealth of a reasonable material standard for all its people, the Duke of Edinburgh, delivering the 7th Graham Clark lecture to a meeting of the three senior institutions, laid the main responsibility for reaching the target on engineers.

Preparing the lecture, the Duke had the great advantage of touring India and Pakistan and seeing the problems of the developing nations at first hand. Perhaps partly for this reason the leeway the Commonwealth has yet to make up to bring its standards of agricultural production and power output even up to world average figures came through starkly as the Duke developed his arguments.

Measured in land area, the Commonwealth has 23 per cent of the world's surface within its various borders; it also has 24 per cent of the world population. Against this only its production of rice (24 per cent) barley (20 per cent), and mutton (23 per cent) are in proportion to the Commonwealth's fraction of world population. Other food products are far below 20 per cent of the total world output. Coarse grains are only 9 per cent, pigmeat 5 per cent and wheat 14 per cent. These figures are some measure of the contribution needed from engineers in raising agricultural standards, particularly in the less advanced territories.

Wider Audience

The Duke is by no means the first to draw attention to these problems, made all the more pressing by the sweeping increases in population going on throughout the Commonwealth, a population growth that sometimes seems to be in inverse ratio to the wealth of the nation concerned. The fact that the position has been clearly stated by a figurehead above controversy changes the situation in so far as the need, and the great difficulties in engineering the solution, are brought home to a much wider audience than may be reached through learned journals and the discussion of small groups of scientists and administrators.

Part of the Duke's lecture may, it is hoped, have some effect nearer home. Drawing a gloomy picture of Britain's apparent lethargy in not bringing more of its young people up to university education standard, and our strange acceptance of a hectic three year degree course, when every other country spreads graduate courses over a longer period, the Duke went on to draw some comfort from the promise held out in the White Paper of earlier this year, *Better Opportunities in Technical Education*. Observing that at least the Government now recognize that no new idea from a scientist or designer can become an efficient piece of equipment without the particular skill and ingenuity of technicians, craftsmen and operatives, the Duke added:

"It only remains now for these plans to be matched in that unhappily large section of industry which still does not provide sufficient effective training for its young recruits."

The speeches made by the Duke of Edinburgh have a way of being echoed in quarters far removed from the board rooms of industry and the common rooms of universities and technical colleges. Perhaps the backsliding chiefs of some companies who have so far not been moved to arrange day release or sandwich courses for their young people will be moved to change their ways.

Shipyard Workers Refuse Tender Plea

The suggestion from the Vickers-Armstrongs and Swan Hunter joint concern set up as prospective builders of the new Queen liner, that outworking allowances and travelling time should be foregone by their employees in order to make their tender more competitive, has been turned down by the local federated union committee.

Shipbuilding workers on the Tyne who are working for their employers other than in the company's shipyard are paid an outworking allowance of 2*s* 6*d* a day. It is also customary to allow travelling time, usually half an hour at the beginning and end of the day. In some cases travelling time payments have been made.

The Tyne district committee of the Confederation of Shipbuilding and Engineering Unions considered the request from the employers and rejected it, taking the view that giving up the allowances would be a retrograde step.

The plan of the Vickers-Armstrongs and Swan Hunter group, if their tender should succeed, is to build the new express liner's hull at Swan Hunters, Wallsend, and then to tow it to the Walker naval yard of Vickers for fitting out. One of the disadvantages of this scheme is the amount of labour interchange between the two firms likely to be involved with the consequent liability for outworking allowances and travelling time. The shipworkers' decision means that the full weight of this drawback will be operating against the company's chance of bringing the Queen tender to Tyneside.

Increasing Urgency of Industrial Safety

The important part played by senior management in making possible conditions for safety in industrial operations is recognised by the first talk to be given to the National Industrial Safety Conference, meeting at Scarborough, 12 to 14 May. The opening paper will be *Safety Begins in the Boardroom*, and it is to be given by Mr. G. H. Beeby, chairman of British Titan Products.

Greater than usual attention is likely to be given to this year's national conference since the accident position in British industry has deteriorated, despite the increasing efforts of the safety officers, their organisations and such allies as house journal editors and others with influence on the shop floor.

There is no lack of need to cut down on the heavy casualty list. Deaths in industrial accidents during 1960 were 665, an increase of 67 over the previous year; non-fatal accidents rose by 15,931 to 189,404.

Safety officers will certainly be heard arguing at Scarborough that local education authorities, particularly in technical schools and colleges, should place greater emphasis on preparing young people to take safety considerations as a necessary and natural part of their lives in industry. Whether or not fire protection is an integral part of the safety officer's duties and the position of the line supervisor as the correct person to accept responsibility for his operators' safety will come up for discussion. A specific point to be considered is whether crane and truck manufacturers, acting with the British Standards Institution, should reach agreement on the positioning of controls on industrial trucks and cranes.

Industrial safety as a subject is one which tends for good reasons to be thought of primarily in human terms. As the managers of any large operation know, accidents at work are expensive. For the small firm, where a serious accident and the subsequent absence of the casualty may cause dislocation of production, proper organisation of safety measures is plainly a part of good management.

Tape Recording Professional Experience

The Medical Recording Service of the College of General Practioners, a scheme in which doctors receive tape recorded talks on medical subjects and also join in taped discussion groups, adding their comments and passing the recording to the next practitioner on the circuit, is of more than passing interest to the equally busy professional engineer.

MRS first began, back in 1957 with 27 volunteers, as part of the answer to helping the hard pressed doctor, with a busy practice and very little time for family life let alone going on refresher courses, to keep abreast of current thinking and new developments.

The operation of the system is relatively simple. Two Essex doctors, Dr. John Graves, and his wife Dr. Valerie Graves, of Writtle, run the service from their home. Speakers on a wide variety of subjects record talks, mostly of about 30 minutes.

Six selected recordings are sent each year to listening groups, generally of about ten doctors who pass the recordings on from one member to the next. Tape recorded discussion groups are in constant session. At the Graves' lecture to the British Medical Association's annual Clinical Meeting, which this year was held at Canterbury, a recording was played back of three doctors exchanging their comments (some add in audible symptoms) from South Croydon, Surrey; Ashington, Northumberland; and Barry, Glamorgan.

Tapes and discs are now sent all over the world, including Australia and New Zealand, Kenya, Israel and Malaya. Last year the secretary of the Canadian College of General Practice travelled to the BMA's clinical meeting in Edinburgh and learned of the scheme from Dr. John Graves. MRS now sends recordings to Canada where distance can be much more of a problem for doctors than in Britain.

Colour pictures go along with some of the recordings and for a few doctors at least going out on their rounds now begins with loading the tape recorder and the colour camera into the car along with the other medical instruments.

The heavily engaged engineer is no more able to get away from his company for specialist courses than most doctors. He, too, has quite enough, if not too much, reading matter to tackle during the day and in his leisure time if he is endeavouring to keep up with even a part of what is published on his own subject and industry.

Some doctors have reported that using the taped talks and seeing the accompanying colour pictures has given them a new approach to the subject and enlivened their subsequent reading. As a method of taking in new information and considering fresh opinions, listening to a tape recording of a practised speaker seems to be an eminently painless way of covering the ground. Given a day with too many appointments and too much travelling it is possible to imagine the doctor driving between calls, listening to the talk as he goes.

In practice the tendency is for the talks to be heard by groups of three or four doctors assembling in each other's homes for the purpose.

Whether some alert engineer will start up something similar waits to be seen. Perhaps the Engineers' Guild have some views on the subject. Certainly the same underlying causes that led to the start of this imaginative use of the tape recorder for the medical profession apply to engineers, and there is no lack of engineering problems common to Australia, to West Africa and to Newcastle or Southampton.

Research Director for St. Dunstan's

St. Dunstan's, the organization for war blinded men and women, is to appoint a director of research. He will be Mr. Richard Dufton, who was blinded in a Plymouth air raid in 1941, having served for seven years in the Royal Navy. Joining the Miles Aircraft company, of Reading, Mr. Dufton, who had almost completed a two year engineering course when he lost his sight, worked on technical liaison and engine development. Working on the ball point pen project from 1944, Mr. Dufton was chief designer in this division of the company from 1948 to 1953.

As research director at St. Dunstan's Mr. Dufton will advise the Council on technical affairs and on research and will act as executive officer for the scientific committee and the workshops development committee. The scientific committee is engaged on projects with guiding and reading devices. The workshops committee handles new devices for overcoming the difficulties of the blind at home or at work.

AEI Easter School on Electrical Engineering

Head teachers and senior science masters from 50 schools attended the Associated Electrical Industries' Easter School, held at Trafford Park from 12 to 14 April.

Welcomed by Sir Willis Jackson, AEI's director of Research and Education, the teachers heard lectures from C. H. Flurscheim, director and chief electrical engineer, R. F. Marshall, the central education manager, and Dr. D. M. Dodds, manager of the research department at Trafford Park.

The programme of visits took in the radio telescope at Jodrell Bank, the apprentice school, Trafford Park, and the main manufacturing department.

Soviet Space Flight Facts Reconciled

The announcements from Moscow are tantalizingly incomplete, but several deductions can be made from the Russian statements.

By G. V. E. Thompson, B.Sc.(Eng.), F.B.I.S.

ON WEDNESDAY, 12 August, 1961, Major Yuri Alekseevich Gagarin made the first successful manned flight into space. Taking off from an unknown rocket base (presumably either Kapustin Yar, 60 miles ESE of Stalingrad, or Aralsk, N of the Aral Sea) at 7.07 BST, according to the Russian account, he circled the Earth, passing over Siberia, south-east across the Pacific Ocean, then across South America, and north-eastwards over Africa back towards Russia. Starting his descent at 8.25 BST, he landed at 8.55.

The journey time of 108 minutes includes the time spent in climbing up to orbit and descending again, 89.1 minutes being the actual, though theoretical, orbital period. An elliptical orbit, with perigee 109 miles and apogee 187 miles above the Earth's surface, was employed, the inclination to the equator being 65° 4′. His maximum speed would be about 18,000 mph (compare that with just under 3,000 mph attained by the pilot of a United States rocket aircraft a few days before). So, in addition to being the first man in space and having made the fastest round-the-world flight, Major Gagarin can claim world records for altitude and speed. However, the scientific value of his flight is above such considerations.

Some experiments were carried out during the flight. We do not yet know what they all were, but obviously having man in orbit was the greatest experiment of them all. Major Gagarin has given us information which could never be obtained with instruments. He experienced several minutes of increased *g*-stress during launching, followed apparently by over an hour in the weightless state; it is possible to simulate the former in a giant centrifuge, but weightlessness can only be maintained for a few seconds, by special aircraft acrobatics, so that it was difficult to know what would happen over prolonged periods. As it happens, Major Gagarin experienced no difficulties from weightlessness, but it could not be assumed in advance that that would be the case. He also had an hour's exposure to cosmic radiation. No immediate effects have been reported, but time alone will tell whether he has escaped unscathed.

The daily press has featured Major Gagarin's account of how he could see the Earth's curvature, distinguish surface features and observe a light blue horizon—it is strange to realize that among the 50-odd satellites which have been put into orbit since Sputnik I, not one contained *colour* TV.

450 TONS LAUNCHED

The Russians have always been reticent about their launching vehicles, but they have at last released a scrap of information: the launching mass of the whole vehicle is given as about 450 tons. This is somewhat heavier than had been expected. Its payload—the present spaceship "Vostok" (East)—weighs about 4½ tons fully loaded, and thus appears to be similar to the satellites which Russia has been launching since August, 1960.

Excluding the satellite used to launch the probe now approaching Venus, there were five previous satellites in this series which more or less achieved success. They were used both to test and perfect the spaceship design and to study the behaviour of animals and biological specimens. The biological experiments presumably were satisfactory; Sputnik 6 was a failure, burning up in the atmosphere during the attempt at recovery, but apparently the defect was found and remedied. Rumours that unsuccessful manned attempts took place before Vostok have been denied, and it is relevant to note in this connection that Gagarin's flight was announced by the Russians while he was still in orbit, with the hazards of re-entry and descent yet to come.

From the engineering viewpoint, the means adopted for re-entry is probably the most interesting aspect of the flight, since there is still considerable discussion in the West as to the relative merits of rocket braking, ablative shields, drag brakes, wings and parachutes for effecting the descent from orbit. In practice, a combination of two or more of these would be used: thus, re-entry might be initiated by firing a retro-rocket, to be followed by use of some device for increasing drag, and then a final descent by parachute. This pattern of events was probably followed by Vostok, but no information has been released by the Russians concerning the important middle phase of the descent. It is not likely that they will do so, as manned satellites have military applications; though the United States has recovered several Discoverer capsules from orbit, these weigh only 300 lb each.

Russian Earth Satellites

Date launched	Name	Mass, tons
4 Oct. '57	Sputnik 1	0·09
3 Nov. '57	Sputnik 2	0·5
15 May '58	Sputnik 3	1·37
4 Oct. '59	Lunik 3	0·27
15 May '60	Sputnik 4	2
19 Aug. '60	Sputnik 5	4·5
1 Dec. '60	Sputnik 6	4·5
4 Feb. '61	Sputnik 7	6·4
12 Feb. '61	Sputnik 8	(Launched 0·63 ton Venus probe)
9 Mar. '61	Sputnik 9	4·5
25 Mar. '61	Sputnik 10	4·5
12 Apr. '61	Vostok	4·5

What information can we glean from the data the Russians have released? The difference between journey time and orbit period is about 19 minutes, and some commentators have taken this as the time required for acceleration to and deceleration from the orbital velocity. This is unlikely: unless the pilot could withstand extremely high acceleration forces, the ascent must have taken at least 5 minutes, which would leave less than 14 minutes for deceleration, including the comparatively slow parachute drop (or glide, if wings were used). However, the official announcement stated that the ship's braking system was put into operation 30 minutes before the landing, so that it is evident that the orbital period referred to is theoretical, and the unpowered flight did not last for a complete orbit. Gagarin later stated that "the return from weightlessness to gravitation was gradual and smooth." Considering these facts in conjunction with the claimed ability to land a satellite within about 5 miles of a specified location, it seems likely that a liquid-propellent engine was used to initiate re-entry. This could be stopped and restarted (and possibly throttled) and thus bring the vessel into the preferred descent path. This ability was obviously desirable, in case the ship had not been placed in quite the intended orbit.

Before the retro-rocket was fired, the ship must have been turned into the correct orientation (rocket nozzle facing forward, i.e., in the general direction of motion). It would also be necessary to kill spin or tumbling of the vessel at the start of the flight. Furthermore, though little mention has been made of tasks alloted to Major Gagarin, he may have been requested to carry out simple manoeuvres, such as orientation changes, during the course of the flight. For all these purposes, the ship would have to be fitted with small auxiliary jets. These might be liquid-propellent rockets or nozzles supplied with gas from cylinders.

The impulse necessary to bring the vessel into the required descent path would be computed on the ground from the observed orbit. Actual firing of the rocket could be controlled directly from the ground, or might be done by the pilot under instructions radioed from the ground. Possibly controls for both methods might be provided—automatic control from the ground was certainly used for the unmanned satellite (and would be needed if the pilot became unconscious or otherwise unfit), but the military might require him to be able to use the controls. Pilots would probably prefer such an arrangement, since it does enable them to do something to save themselves in an emergency, such as failure of the radio link. If both methods were used, the ground could have over-riding authority.

THAT PORTHOLE

The material of construction of the porthole is another closely-guarded secret. In case it is thought surprising that a porthole or portholes should have been provided—as these must withstand high thermal and mechanical loads, vibration, expansion and contraction, and possible encounters with micrometeorites—it is worth noting that America also is incorporating them in her manned space vehicles. Although it would be quite possible to use closed-circuit TV to enable the pilot to see where he is going, the Americans consider viewports essential because of the psychological factor; presumably the Russians think the same.

The United States manned spacecraft project nearest being flown is Mercury, a rocket-launched orbital vehicle which will return to Earth on a ballistic trajectory.

The first manned Mercury capsule is scheduled for firing later this month; delays have been experienced in the programme. It will only be a sub-orbital (ballistic) flight; the first manned orbit shot is not expected until late 1961 or early 1962, and this will be put back further if the sub-orbital flight is not perfect. The Mercury capsule weighs 1 ton, in comparison with the 4½ tons of Vostok, so there is thus a parallel here with what happened in 1957. The USA were then hoping to place the 20 lb Vanguard satellites in orbit when Russia suddenly announced that she had launched the 184 lb Sputnik I. In each case America has tried to do the job as economically as possible by working to the minimum-sized launcher, and Russia has employed one more than big enough for the task.

It is taken for granted in the west that the Russian vehicles employ conventional "low-performance" propellents. If this is true—and it is really only a guess, for the Russians have never disclosed which propellents they use—it also implies that the performance of the Soviet vehicles can be considerably improved by changing to liquid hydrogen.

Gagarin has stated that Russia is now building special spaceships for trips to the Moon. The first flights are likely to be round the Moon and back, to obtain more information about suitable landing sites; landing and return will be much more difficult. Circumlunar flights could be made possible by using better propellents, but the Russians may also be intending to add an additional stage to their vehicle.

If America is to catch up with Russia in this field, it thus looks as if it will not be enough merely to press ahead with the Mercury and Saturn programmes; it will be necessary to reactivate the Nova project, or make a fresh approach to the problem. The Saturn project is very flexible: by varying the combinations of different engines and numbers of stages it is intended to launch manned satellites, carry out circumlunar flights, make lunar landings, and so on. The programme might be accelerated by shelving some of the many projects for instrumented satellites and by spreading construction of Saturn vehicles over a wider sector of the United States rocket industry.

Quickening Traffic on the River Trent

Increasing the size of the locks, and mechanizing the gates, together with better river control works, will give faster operation of river-borne traffic.

WORK is nearing completion on a scheme of improvement costing £473,000 on the River Trent Navigation between Nottingham and Cromwell, five miles below Newark. The scheme, launched by British Waterways just under four years ago, aims at removing bottlenecks and developing this important waterway which links the Humber ports and the Midlands.

By the end of this year over £400,000 will have been spent on the following main items:

£81,700, bank protection in steel and concrete sheet piling.
£75,500, steel piling and concreting to consolidate the main river weirs.
£51,700, mechanization of locks.
£163,400, dredging plant and equipment.
£39,100, extension of Cromwell Lock.
£2,400, repair yard plant.

The River Trent rises in the Staffordshire Hills near Stoke-on-Trent and flows via Burton-on-Trent, Shardlow, Nottingham, Newark, and Gainsborough, to Trent Falls, where it joins the River Humber and thence to the sea. It is tidal to Cromwell Lock, where the first of six large locks was constructed in 1911. Until 1951 there was a bottleneck at Newark formed by the old single-boat Town Lock, and authority was obtained to construct a large four-boat lock alongside the old lock; this was opened in 1952. The River Trent Board have since completed a big flood prevention scheme at Holme, where large sluices have been built and a new river channel cut, dispensing with Colwick Weir and Holme Flood Lock. As a result of these improvements, craft 140 ft long with a beam of 18 ft 6 in are now able to navigate up to Trent Bridge, Nottingham.

Lock Mechanization

One of the principal features of the scheme is the mechanization of seven main locks, which will not only minimize the considerable physical effort involved but will cut the time taken by about half and so speed the movement of traffic. Already the locks at Newark Town, and Cromwell have been mechanized, and two more—Newark Nether, and Gunthorpe—are nearing completion. It is hoped to start work on the remaining three—Hazleford, Stoke, and Holme—later this year or early in 1962. Extensive use has been made of installations by Stein Atkinson Vickers Hydraulics Limited.

Cromwell Lock Extension

Cromwell Lock, the lowest lock on the River Trent, is situated five miles downstream of Newark, at the limit of tidal influence. The lock, as built in 1911 by the former Trent Navigation Company, had two pairs of gates and was 187 ft long between hollow quoins and 30 ft wide. It accommodated four standard Trent barges or one large oil tanker, but was not deep enough to pass craft through at all downstream water levels. To alleviate the congestion of traffic which occurred below the lock during periods of drought and prolonged low water level, a third pair of shallow gates was built 25 years ago below the lock tail, to form a " two rise " lock for raising and lowering vessels in two stages. In practice, the arrangement was not very satisfactory and to overcome the delays which occurred, and to avoid the high cost of building a second lock alongside the existing one, it was decided to replace the third pair of gates with deep gates, extending up to cope level, in a new gate chamber. The lock, thus lengthened, would enable eight standard barges or three large oil tankers to pass through in one locking operation when the downstream water is at or above normal level; and in periods when it is below normal, two large oil tankers would still be able to pass at one time.

It was essential that there should be as little interruption as possible to traffic during the lengthening of the lock, and, when tenders for the work were invited, it was made a condition that the only lengthy stoppage would be for eight days at the beginning of August, 1960.

In March, 1960, a contract was placed with Tarslag Limited of Rotherham and work commenced forthwith.

The two side walls of the new gate chamber were constructed consecutively in steel piled cofferdams, and as each cofferdam in turn projected into the waterway, access to the lock was restricted somewhat.

In accordance with the pre-arranged schedule of work, the lock was closed to traffic at midnight on 30 July and work proceeded continuously with day and night shifts. A steel sheet-piled dam at the downstream end was closed and the excavation for and concreting of the invert undertaken. A pair of steel gates, fabricated by the Consett Iron Company Limited, which had been brought from Consett by road to the site, was lowered into the lock chamber and placed in position. Traffic through the lock restarted on 8 August.

The left bank of the river downstream of the new gate chamber was trimmed back to a 2 to 1 slope and faced with stone pitching up to normal high water level. In front of the bank, three dolphins were constructed, each consisting of four steel box piles strongly braced with steel members and a heavy reinforced concrete cap.

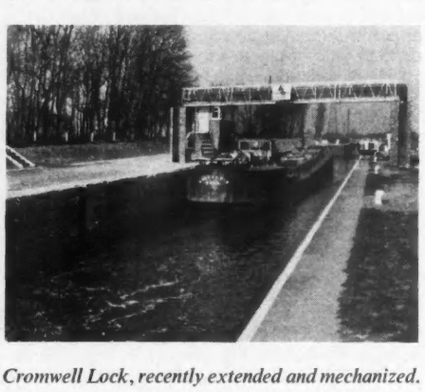
Dredging Plant

Considerable dredging work is constantly necessary on the River Trent and new dredging plant and equipment provided under the scheme has strengthened and modernized the existing fleet to the extent that tonnages removed from the river have risen from 184,000 tons in 1954 to over 283,000 tons last year. The new plant and equipment includes three diesel bucket dredgers, two additional bottom-tipping hopper boats, ten dredging hoppers, two diesel tugs for hauling hopper boats, an excavator for bank work, and three diesel cranes.

Cromwell Weir

Apart from the projects covered by the £473,000 scheme, a major work on the Trent has been the complete reconstruction of Cromwell Weir at a cost of £270,000.

Cromwell Weir, adjoining Cromwell Lock, was originally about 130 ft long and built of concrete in bags. It was outflanked on the right bank during the first winter following its construction and at intervals during subsequent years, and successive remedial measures gradually built up alongside weir. The side weir was again outflanked in January, 1955, when extensive erosion of the right river bank took place. Emergency measures were taken to close the weir by dumping stone from barges, but the situation remained critical for some weeks.



Cromwell Lock, recently extended and mechanized.

Coode & Partners, consulting engineers, of London, were therefore invited by British Waterways to prepare a scheme for the construction of a new weir, as a matter of urgency.

Trial borings on the site showed sand and gravel overlaying marl, the marl being found at about − 1·0 OD (Newlyn). The downstream water level varied from + 10 OD at low water to + 30 OD in severe floods. Essential requirements were that the flow from the new weir should not hamper river traffic approaching the lock from downstream, and that it should not cause silting in the channel leading to the lock.

Cromwell Wier, rebuilt of mass concrete and sheet piling, with the fish ladder in foreground.

Preliminary designs for a curved weir were tested at the British Waterways Laboratory at Bulls Bridge, Southall, Middlesex, and the River Trent Board also studied the design. The results of the tests were satisfactory, but it was found possible to shorten the weir slightly, without detriment, by increasing its radius of curvature, which in the final design was made 480 ft. The left abutment of the weir rested on the lock island, which was to be extended about 172 ft downstream and the right abutment was extended both upstream and downstream by training walls to an overall length of over 1,850 ft, to ensure that the river stayed in its channel. The training walls were to be faced with concrete slabs jointed with a bitumen-asbestos mixture. In order that not more than 40 per cent of the river should be closed at any one time, the River Board required that the new weir should be constructed in three stages and the height of the cofferdam piles above normal water level limited so that they would be overtopped by severe floods. A fish ladder was required to a design approved by the Ministry of Agriculture and Fisheries and this is located adjacent to the left abutment. It contains seven pools, each 10ft 6 in by 6 ft 0 in and with a vertical rise of 1 ft 6 in.

A contract was placed with A. Monk & Company Limited of Warrington in August, 1956, and work commenced immediately, starting with the construction of an access road.

Steady progress was made despite difficulties arising due to flooding, particularly during the wet summer and autumn of 1958. The flooding was particularly troublesome during the most interesting stage involving the construction of the cofferdam for the third and final section of the weir, the section adjoining the lock. This involved closure of the river and its diversion over the two previously completed sections. A model of the contractor's proposed scheme was tested at the Research Laboratory and after certain adjustments, pronounced satisfactory. The scheme was put into operation and proved quite successful. These works were completed in January, 1959.

Showing at the Engineering, Marine, Welding and Nuclear Energy Exhibition

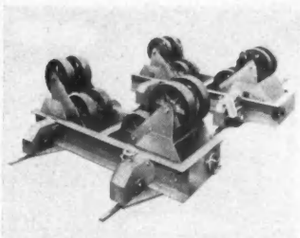
Olympia, London
20 April to 4 May

YESTERDAY saw the opening of the bi-annual engineering exhibition where over 500 stands are displaying goods. Some would-be exhibitors had to be refused owing to lack of space, and all three halls at Olympia are being used to capacity. The thousands of exhibits cover the whole field of engineering and include many ancillary processes such as corrosion prevention, radiography, fire prevention and protective clothing. Those who are showing items of nuclear equipment are displaying a plaque to that effect—their exhibits range from special photographic emulsions to reactor models.

The diversity of products is enormous: there are boilers, chronometers accurate to 15 seconds per year, diesel engines (the largest weighs 91 tons and there is a model of one weighing 885 tons) and tubes one-quarter the size of a human hair. The exhibition is organized by F. W. Bridges and Sons Limited, Grand Buildings, Trafalgar Square, London, WC2, and ENGINEERING's own stand is in the middle of the Grand Hall on the ground floor. This and the following three pages contain descriptions of some of the exhibits—others were given last week.

ROTATOR SET

With Integral Travelling Bogies



VESSELS from 2 ft to 12 ft diameter can be accommodated on the Yates self-aligning rotator set illustrated.

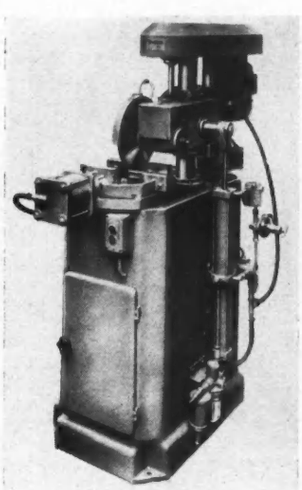
The set comprises a power unit and an idler unit both mounted on bogies. No declutching is needed when lowering vessels on to the rotators, and tilt spring rollers are incorporated which automatically swing each carriage into the correct position. Small pipes down to 4 in diameter can be handled by moving one carriage of each unit to the horizontal position and setting with a lock. The floating friction final drive provides a safety device which will slip at a given torque.

The frame is a welded structure with an integral bogie frame. Each unit is independent and the power unit can be traversed on 4 ft 8½ in shop track at infinitely variable welding speeds. A four wheel drive with flanged wheels on one side and plain on the other gives smooth movement without nosing. The traversing motors drive through two worm gears and a slipping clutch allows the unit to free-wheel and prevents damage if an obstruction is hit.

A Ward-Leonard set gives a range of welding speeds from 4 in to 40 in per minute for both rotational and traversing movements. A changeover switch selects either. A control box is mounted on the power unit frame and is fitted with a visual welding speed indicator (calibrated in inches per minute) speed controller and start-stop buttons, reversing switch and pilot light. The box can be detached if desired and mounted on a boom or other convenient location. Power units can be ganged if required to operate as a single unit. *Baker Perkins Limited, Westwood Works, Peterborough.*

CIRCULAR SAW

Pneumatic Cycle Control



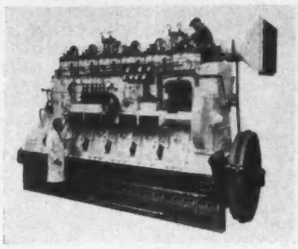
ACCURACY and cleanness of cut are two claims for the Winter 250 semi-automatic saw.

The complete working cycle of the machine is controlled and operated by air valves and cylinders. With a saw 9·8 in diameter the capacity for round bar is 3·15 in and for square sections up to 2·75 in. Power is supplied by a 1·5 or a 2 hp motor according to whether the machine is intended for ferrous or non-ferrous metals. Each has a range of four speeds, the former being from 30 to 68 rpm and the latter from 510 to 1,120 rpm. The head has a vertical travel of 7·87 in, and the machine requires a floor space of approximately 27½ in by 20½ in.

The saw head slides on two hardened and ground columns and adjustment to take up slack is provided on both. The accuracy is to 0·002 in per in. Pneumatically operated vices are supplied with the machine, the opening and clamping of which is automatically controlled by the raising and lowering of the saw head. A coolant pump and settling tank are included in the base. *Addison Tool Company Limited, 28 Marshalsea Road, London, SE1.*

MARINE DIESEL ENGINE

Loop Scavenged



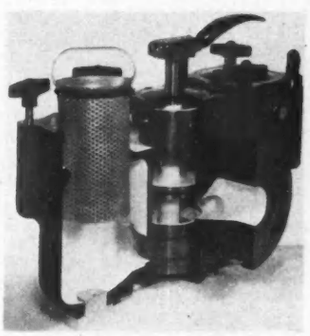
BOTH SUPERCHARGED and normally aspirated versions of the recently introduced N type marine diesel engine are available.

The cylinders have a bore and stroke of 340 m by 570 mm. All versions are loop scavenged by a valveless system. Scavenging air for the non-pressure charged version is obtained from a positive displacement double acting pump. Supercharging is achieved by the pulse pressure system, the cylinders being grouped in threes in the six and nine cylinder versions and in fours in the four and eight cylinder models. One turbocharger is provided for each group and operates in conjunction with a motor driven fan. This feeds the turbocharger, and the scavenge air then passes through an intercooler on the manifold. The fans ensure ample air for starting and manoeuvring and are switched off for normal running.

Pilot injection is used embodying a jerk pump. All starting, stopping, reversing and speed setting is carried out by two concentric shaft mounted levers at the centre of the engine. This is claimed to cut down operator fatigue and operational mistakes. The engine is controlled by a hydraulic governor. *British Polar Engines Limited, Helen Street, Glasgow, SW1.*

FILTER

Seawater and Oils



THE UNIPLEX and Biplex ranges of filters are designed to remove suspended solids from fuel oils, quench oils, hydraulic oils and coal tar fluids as well as from seawater coolant.

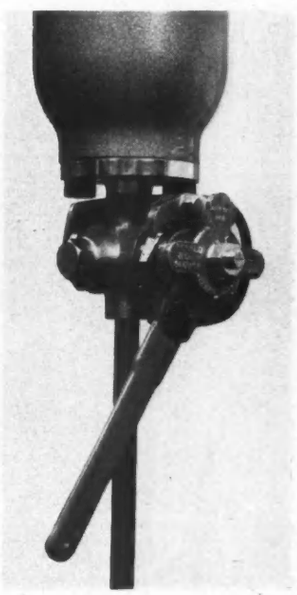
The double chamber Biplex unit is illustrated. Its use allows filtration to continue while one unit is being cleaned; control being by the centrally placed valve. For cleaning, the basket is simply lifted out, an easy operation as the cover is secured only by wing nuts. The flow of fluid is from above into the basket and out through the mesh at a point above he trapment area at the bottom.

Filter bodies are made of cast iron and so are the cover plates for sizes up to 1½ in. Above this malleable iron is used. The rotary valve is cast iron. The filter basket has ⅛ in holes in the steel plate and can be fitted with stainless steel gauzes from 10 to 200 mesh. Standard materials allow operation at temperatures up to 120° C and pressures up to 150 lb per sq. in, and the handling of fluids other than tars, crude benzol and seawater. For these and for higher temperatures and pressures special materials are available.

It is claimed that the valve of the Biplex unit never shuts off the flow from both chambers simultaneously. It does, however, allow for both to be operated simultaneously which is useful for high viscosity oils and when starting up from cold. Standard bore sizes are from ½ in to 6 in. *Zwicky Limited, Buckingham Avenue, Slough, Buckinghamshire.*

BLOW-DOWN COCK

Sequence Operation



A SEQUENCING blow-down cock for steam boiler and feed water controls and alarms is ratchet operated so that the correct procedure for blowing the float chamber is always followed.

The first movement of the lever of the Mobrey cock releases the locking device, isolates the water connection from the boiler shell and blows down the float chamber bringing the level control or alarm to the "failed safe" position. Further operation of the lever isolates the float chamber, blowing the water connection between the cock and the boiler shell, so that both are blown together, and returning finally to the normal operating position when the locking pawlaut omatically re-engages.

Six versions of the valve are available for pressures of 145 or 250 lb per sq. in and for right or left hand operation. Standard flange connections are for ¾ in and 1 in pipe. *Ronald Trist and Company Limited, Bath Road, Slough, Buckinghamshire.*

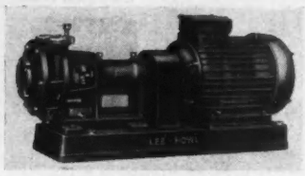
CHEMICAL PUMP

Highly Corrosive Liquors

HIGHLY corrosive liquors such as sulphuric acid at any concentration or temperature can be handled by a new Hypersilid chemical pump.

The pump is made from silicon iron castings and will handle trade effluents generally as well as acids. The 2/2½ in model has an output of 75 gallons per minute at a head of 153 ft increasing to 187 gpm at 86 ft head when using the maximum impeller diameter. With the minimum impeller diameter, the outputs are reduced to 65 gpm at 86 ft head, and 150 gpm at 51 ft head. The standard running speed is 2,900 rpm.

No wear rings are fitted and the impeller running clearance is generous; this avoids rapid loss in pumping efficiency resulting from wear and corrosion. All the parts in contact with the liquor being pumped are of silicon iron and other parts are fine grain grey iron castings. The pump shaft is made of Staybrite steel and is protected against liquid drippings by a high silicon iron wearing sleeve extending through the



whole depth of the stuffing box. The impeller and shaft assembly can be quickly removed as a unit through the pump casing without disturbing the bearings or other components. Two widely spaced ball and roller bearings are fitted in the cast iron headstock. The casing is the volute type with ample wall thickness to allow for the working pressure under corrosive conditions.

The pump can be fitted with soft gland packing or with a mechanical seal, both interchangeable. For the soft packing the gland and bush are split. The stuffing box is made of plastic material and a Stauffer type lubricator is used. For the mechanical seal the box gland and lantern ring are replaced by a clamping plate. The casing is tested up to 100 lb per sq. in. *Lee, Howl and Company Limited, Tipton, Staffordshire.*

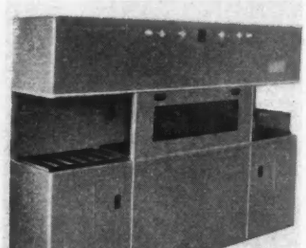
AUTOMATIC WASHER

Platform Agitation

BASKETS of workpieces up to 80 lb in weight can be handled in a new automatic washing machine with a tank capacity of 30 gallons.

The complete unit comprises a two stage wash and rinse section with roller track units for loading and unloading. The whole is mounted on mild steel angles with continuous flush panelling enamelled with chemically resistant paint. Overall dimensions are 8 ft 4 in long by 2 ft 6 in wide and 6 ft high. In operation the work baskets are moved into position by means of an overhead travelling arm operated pneumatically and concealed in a canopy hood. An electronic timing device controls the cycles, and the air operating circuits are so arranged that the push arm cannot move unless both the platforms are at the tank top level.

Loading and unloading is a single operation and two baskets can be handled simultaneously by means of a single control which also operates and controls the agitation cycles.



The agitation motion is performed by two 3 in air cylinders mounted on ball joints and located externally at the rear of the unit. Position and length of stroke are adjustable, the standard rate being 90 strokes per minute. The platform moves vertically on rollers running on twin guides carrying baskets measuring 20 in by 18 in by 12 in deep. The air supply required is 80 lb per sq. in. *Revel Engineering Company Limited, Hayes Road, Southall, Middlesex.*

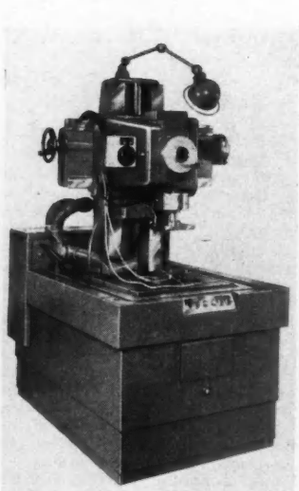
SPARK EROSION EQUIPMENT

1 Ton Workpieces

WORKPIECES up to 1 ton in weight can be handled on the Seleromat B spark erosion machine illustrated.

The erosion head is mounted on precision coordinate slides providing accurate positioning of the electrode over the workpiece with movements of 9 in by 12 in. The slide assembly is carried on twin scraped slideways on a massive column at the rear of the machine, vertical movement being controlled by a worm driven telescopic screw. The transverse slide is mounted on the longitudinal slide and both are operated by leadscrews with micrometer drums, divided in 0·001 in graduations. An optical vernier equipment is also available.

The table measures 20 in by 24 in and the vertical travel is 20 in. The maximum height under the electrode is 30 in and the minimum 4 in. The servo controlled movement of the head is 4 in. The machine operates from 440V 3 phase supplies and associated equipment available includes a spark generator



and a dielectric filter. *Solar Weld Languepin Limited, Fulledge Works, Burnley, Lancashire.*

DIESEL ENGINES

Supercharged to 1,700 hp

ILLUSTRATED is the 16 cylinder model of the MGO series of general purpose diesel engines.

These are made as six in-line and as 6, 8, 12, and 16 cylinder 60°V models with a choice of two degrees of supercharging and with or without intercooling and piston cooling. They are based on a 275 cu. in cylinder unit with bore and stroke of 175 by 180 mm. The V type engines have articulated connecting rods with strokes of 192 mm. Mean piston speed at 1,500 rpm is 1,772 ft per minute for the master rod.

The cylinder frame is a single piece iron casting except where weight is at a premium, when a steel fabrication is used. The main bearings are machined in the block. The individual cylinder heads are cast iron and have four valves with alloy inserts. The injection nozzle is centrally located. The forged alloy pistons have a combustion chamber in the crown and cooling oil can be circulated through an internal groove. Gudgeon pins are case hardened. The

wet liners are of centrifugally cast iron, nitrided and lapped.

In the V engines the connecting rod assembly is of the master and articulated type with the link at the crank end. The crankshaft is flow forged in chromium molybdenum steel with induction hardened pins. A torsional vibration damper is fitted. Micro bearing type shells are fitted either in the main bearings or in the big ends, and are lined with copper-lead on a steel backing. The helical timing gear train also drives the injection pumps, the ball governor and the auxiliary power take-off. *Societé Alsacienne de Constructions Mécaniques, Mulhouse, Haute-Rhin, France.*

GYRO COMPASS

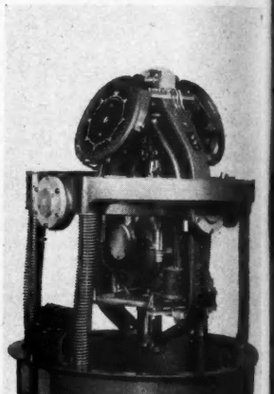
Up to Eight Repeaters

THE Mark XX gyro compass for marine installations is now coming on the market.

The instrument is compact and requires little room for installation. It is designed in two versions for use as a bridge master compass incorporating two repeater dials (one being of the enlarged scale type) and transmission for up to eight repeaters; and as a master compass located away from the wheelhouse, again incorporating transmission for eight repeaters.

The compass is supplied from a 400 cycle motor generator set with a choice of inputs for all normal requirements. The set is mounted separately which allows the transmission unit and terminal blocks to be built into the blower part of the binnacle (not shown in the illustration), eliminating the need for separate cubicles and cable runs. Space is saved by using a transistor amplifier.

Operational features include provision for setting in speed and latitude corrections by electrical means in such a



way that master and repeaters all read (the same) true course. These controls can be seen on the left of the unit. A separate alarm unit is available and easy access to the connection blocks is a special feature. *Sperry Gyroscope Company Limited, Great West Road, Brentford, Middlesex.*

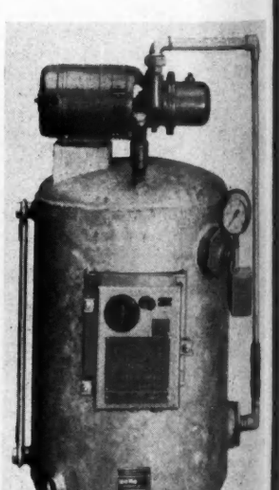
PRESSURE SYSTEM

For Ship's Water Supply

A UNIT for use on low tonnage vessels or for individual supplies on large ones is the latest addition to the range of water pressure sets.

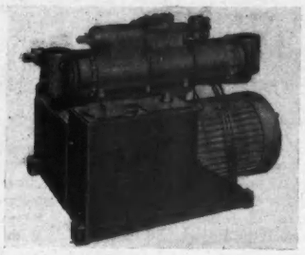
The type M Minipack incorporates a 20 gallon pressure tank fitted either with feet or brackets for bolting to a bulkhead. With a suction lift of 20 ft the unit can be fitted where desired. All the control equipment as well as the pump is mounted on the tank. The pump is rated for 110 gallons per hour running at 1,500 rpm using a ⅓ hp motor.

The operation is fully automatic. The pump starts running when water is drawn off causing the pressure in the tank to fall. When the air pressure in the tank rises with inflow of water the pump is cut out at the set value. A separate compressed air supply is not required as the pump will handle both air and water. Snifting valves are fitted to the suction branch to allow the entry of air during pumping. *Mono Pumps Limited, Sekford Street, Clerkenwell Green, London, EC1.*



HIGH PRESSURE PUMP

Fixed or Variable Delivery



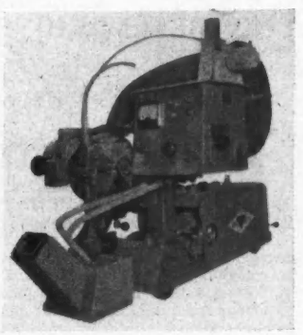
THE LATEST version of the Hydroflo pump, the model H, is designed for general duties on aqueous fluids.

The duty range of the pumps is from 75 gallons per minute at 1,000 lb per sq. in to 10 gallons per minute at 9,000 lb per sq. in. Pumps can be supplied with either fixed or variable output, the latter being usually in the lower part of the range. The output and pressure controls can be for manual operation only; for fully automatic operation; or for a combination of both. The latter would be the automatic maintenance of a manually set condition. Constant pressure control is the standard automatic method.

The Hydroflo pumps consist of an oil transmission pump directly driven by a squirrel cage electric motor. The oil pump feeds the double acting driving piston which is in turn directly connected to the pumping piston. These reciprocate at virtually constant velocity resulting in a smooth continuous delivery characteristic. The oil continually recirculates. The water valve boxes are either high tensile SG iron or forged steel, and fitted with loose renewable valve seats and bronze or stainless steel valves. Multiple valves are used to minimise valve lift. The valves and their seats can be removed from the pump together, as a complete assembly. The water pumping cylinders are hard chromium plated, as also are the rods, to resist wear and corrosion. The low piston velocities and the slow reciprocating speeds make for long life for both pistons and valves. The metal seals used in the oil circuit are self adjusting. *Tangyes Limited, Cornwall Works, Smethwick, Birmingham.*

DECKWELDER

Submerged or Open Arc



THE MURAMATIC deckwelder equipment is designed for using both the submerged and open arc forms of welding.

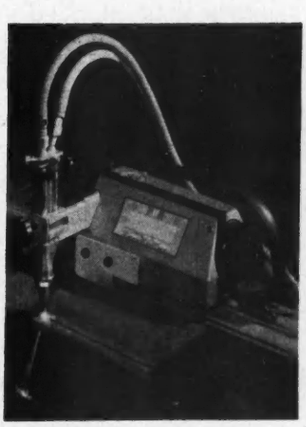
The current supply can be either alternating or direct, the load being up to 1,200 A. It is claimed that the electrode feeding mechanism ensures good welding conditions with a complete absence of hunting. Attached to the head is a control panel with all the necessary electrical controls and instruments grouped together. Mechanical adjustment can be made in the vertical and transverse directions so that the head can be set to the exact position required. There is also angular adjustment for the head to enable fillet welds to be made.

When used in the open arc process the head can be fitted with a combined arc shield and fume extractor hood as shown and a fume extractor fan. For the submerged arc process the shield is replaced with a flux hopper.

The self-propelled carriage has a stepless speed control over a range from 8 to 40 in per minute in both directions. Alternative gears can be fitted for higher speeds. Steering gear is provided and the wheels are grooved for running on track. The cabinet will store four coils of electrode and there are two 850 W heater elements in a special compartment at the bottom with thermostatic control allowing the cabinet to be held at a chosen value between 0 and 300° C. Standard equipment is for 200-250 or 380-440 V supplies. *Murex Welding Processes Limited, Waltham Cross, Hertfordshire.*

OXYGEN CUTTING MACHINE

Lightweight and Portable



A NEW LIGHTWEIGHT oxygen cutting machine will be called the Pug.

The machine proves its claim for lightness as it only weighs 21 lb. It can be used to cut and also to bevel steel plates up to a maximum thickness of 2 in and will cut out circles of any diameter from a minimum of 3 in to a maximum of 45 in diameter. Straight cuts of any length can be made using a light alloy track for a guide. The track is extensible to provide the required length. For cutting circles an adjustable trammel attachment is used. The cutting head can be tilted through any angle up to 45° for making bevel cuts, and can also be adjusted laterally and vertically for close setting.

A universal electric motor, suitable for both alternating and direct current supplies, is fitted to the standard model, versions being available for voltages of 110 or 220-240 volts. The motor gives the machine a welding speed range from 10 to 180 ft per hour, using a rotary type resistance controller mounted at the end. The maximum power consumption is 80 watts.

Mixing occurs at the nozzle giving greater safety and trouble-free cutting. The standard blowpipe is suitable for use with acetylene or propane as the fuel. *British Oxygen Company Limited, Bridgewater House, St. James's, London, SW1.*

LIFEBOAT RADIO

Hand or Automatic

THE Solas lifeboat radio set is a combined transmitter and receiver.

As a transmitter it has a power of 3 to 5 watts in the fixed frequency ranges of 500 kc/s and 8,364 kc/s. As a receiver it has at least 1 mW in the headphones. Reception is over a wide band at 490 to 510 kc/s, uniform to within 6 db, and high frequency reception is optional over 8,266 to 8,745 kc/s. Transmitting frequency change is by a switch.

Power is obtained from a hand generator producing 1·13A at 6·3V and 60mA at 400V approximately. Crystal control gives high stability, better than 0·1 per cent at 500 kc/s or 0·02 per cent at 8,364 kc/s. Receiver selectivity is at least 40 db discrimination relative to the response at 500 kc/s at all frequencies below 460 kc/s and above 540 kc/s. Sensitivity (for 20 db signal to noise ratio) is better than 100V for an output of 1mW in headphones.

The aerial systems give provision on the medium frequency range for capacities ranging from 80 to 150 pF and between 350 and 450 pF. The aerial can be on a collapsible mast or the Solas kite aerial system can be used. A masthead light can be operated from the hand generator. Automatic transmission of the alarm signal is provided followed by the distress signal. Hand operation is from a key on the front panel. *International Marine Radio Company Limited, Progress Way, Croydon, Surrey.*

CUT-OFF MACHINE

For Metallurgical Specimens

MICRO-SECTIONS of hard and soft materials can be prepared in the series M cut-off machines.

Wet cutting is a standard feature of the machines to prevent overheating and to give a smooth surface needing little further treatment. A tank and circulating pump are situated in the base. The work tables are provided with slots for T bolts to secure the pieces. The accessories supplied with the machines include one pair of V blocks, cam clamp, fences, and a pair of clamp plates for holding work that does not need special fixtures.

The machines are made in seven standard sizes with discs ranging from 6 in to 12 in diameter. Heights under the wheel when raised range from 2¼ in to 11 in and the bar capacity is from ½ in to 2½ in diameter. The table widths are from 11½ in to 19 in and the opening in the guard, front to back, varies from 5⅛ in to 12½ in. Driving motors are from 1 to 5 hp.

The motors are totally enclosed and fan cooled for continuous rating. Starters are direct-on-line. The spindle bearings are ball or roller throughout and are protected by labyrinth glands. A wide range of discs is available giving a choice to suit the material to be cut. *A. and S. Osmond Limited, 13 Dowry Square, Bristol 8.*

LIFTER

Operated by Pneumatic Cylinders

THE ILLUSTRATION shows an example of a lifter for raising trays to the working height.

The provision of a convenient working height can reduce fatigue and the provision of means of lifting heavy boxes and trays can remove much effort from a job and can often allow women to be employed. Equally, heavy work pieces can be raised to working height for loading on to a machine table.

Power to raise the arms is supplied by single acting pneumatic cylinders mounted in the main body and working from the works air line at a pressure of 80 lb per sq. in. A bayonet coupling is provided for connecting up, making the unit transportable. Control of the raising and lowering is by two push buttons mounted on the top of the unit, allowing the arms to be positioned at any height required. If desired the arms can be replaced or supplemented by a rugged steel platform which would be more suitable for some types of work. All the working parts of the lift are enclosed preventing the ingress of excessive dirt. The total lift can be made to suit particular applications. *Martonair Limited, Parkshot, Richmond, Surrey.*

HYDRAULIC POWER PACK

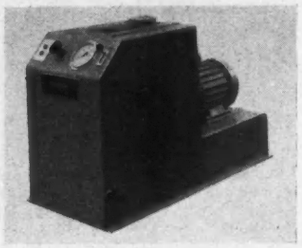
Up to 4,000 lb per sq. in

A SOURCE of hydraulic power for all purposes is now available as the unit illustrated.

This contains a multi cylinder radial pump direct coupled to an electric motor. Four sizes are made with deliveries of 10·25, 17·6, 24·2 and 38 gallons per minute at the lower working pressure. At the maximum pressure these figures are reduced to 4·4, 5·85, 4·0 and 9·5 gallons per minute, respectively. Maximum pressure obtainable in the two larger sizes is 4,000 lb per sq. in.

The pumps are made from a solid block of forged steel. The cylinders and aluminium bronze pistons are micro-finished to ensure minimum oil slip and long life. The pistons are driven from an eccentric section of the centre shaft. There is an inlet and outlet valve to each cylinder. On the former depends the volume delivered which is in inverse ratio to the pressure used, the relationship being automatic according to the load presented to the pump.

By means of the control valve operated



by a hand lever on the control panel, the pump delivery can be adjusted between the limits specified. The adjustable relief valve can be preset to any pressure required within the maximum rating of the pump. The main structure of the pack is welded mild steel, embodying the oil tank, control panel, and platform for the motor. The tank capacity is 75 gallons. The squirrel cage induction motors are rated from 12 to 30 hp according to pump size and run at 1,440 rpm. A pressure gauge and pressure-volume chart are included as standard equipment. *Pearson Machine Tool Company Limited, Walker, Newcastle upon Tyne 6.*

BUTT WELDER

For Fine Wires

WIRES down to 0·01 in diameter can be butt welded in the precision machine illustrated.

This is one of several models in the S range: larger sizes will handle wires up to 0·08 in diameter, and there are versions intended particularly for iron, steel and nickel wires, and for copper, brass and other alloys. A cutter incorporated on the machine ensures that the ends of the wires are truly square.

Once the wires are inserted the whole operation is automatic. An eccentric dial is set to the thickness and the wires are clamped in the chucks. A nut adjusts the upsetting pressure. The weld is made by pushing a button, the timing being automatic. A parallel guiding device ensures alignment, and there is fine adjustment of the weld current. The electrode gap and the cut off point are independently adjustable.

On the head are annealing dies in which the welded wire can be inserted to

relieve stresses. Setting is again by the eccentric dial. Provision is made for removing the burr of the weld, the wire being laid in a notch in a hardened disc which gives support during filing. The machines are available either for bench or pedestal mounting. *H. A. Schlatter Limited, Zollikon-Zurich, Switzerland.*

MULTI-SPINDLE DRILLING MACHINES

Up to $\frac{7}{8}$ in capacity

A NEW range of multi spindle drilling machines is now being produced.

Several special features are put forward for this range. The heads can be positioned on the table to suit any particular requirement of the work in hand and the design enables a total of six heads to be mounted in the same size table as would hold only four of the earlier design. Similarly, additional heads can be offered for those tables previously intended for two and three units respectively.

The design of the legs has been changed to a cut-away form to allow unimpeded foot movements of the operators. In the leg structure there is provision for a foot rest to be fitted if desired.

There are three tables offered at present with working surfaces of 31½ in by 19½ in; 49½ in by 19½ in and 67½ in by 19½ in. There are drill heads with capacities of ½ in and travels of 3½ in and 4 in, and ⅞ in with a travel of 4 in. Maximum distance from chuck to table

is 16 in, 15½ in and 21½ in respectively. Distance from the centre of the spindle to the column is 8 in in the first and 8½ in in the other two. Spindle speeds are from 460 to 2,900 rpm, 340 to 2,580 rpm and 45 to 2,460 rpm. *B. Elliott (Machinery) Limited, Victoria Road, London, NW10.*

LATHE

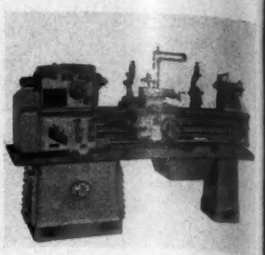
15½ in Swing, 160 in Between Centres

THE IMOR model Min lathe is a precision tool built to Schlesinger limits.

It has a swing of 15½ in and versions are available to take work between centres from 40 in to 160 in. Swing over the cross slide is 9 in and in the gap 23½ in. Width of the gap in front of the faceplate is 7½ in. The spindle is bored 1½ in. The cross slide has a travel of 8 in.

Two speed ranges are available each with six speeds. These are from 44 to 650 or from 80 to 1,120 rpm. There are 144 longitudinal feeds, covering from 0·0035 to 0·09 in per rev, and there are the same number and range of cross feeds. The lead screw has a pitch of 4 tpi. Drive is from a 3 hp motor.

The bed is of iron alloy with internal ribbing and has ground prismatic guides. The headstock has a ground spindle running in Timken taper roller bearings. The gears are nickel chromium molybdenum steel and have automatic pump lubrication. The feed device on



the apron incorporates a safety overload to prevent damage. On the carriage is a quick change toolpost and six tool blocks. The feed box is the Norton type enabling 144 pitches and 144 feeds to be obtained. Lubrication is by hand pump. The tailstock is provided with internal ribbing and has instant locking. There is lateral adjustment for taper turning. The motor is mounted on a swivelling plate with external drive. The belts drive on to a pulley mounted in a cavity isolated from the headstock gears so that belts can be changed in less than 2 minutes. *Gate Machinery Company Limited, 172-178 Victoria Road, Acton, London, W3.*

UNIVERSAL MACHINE

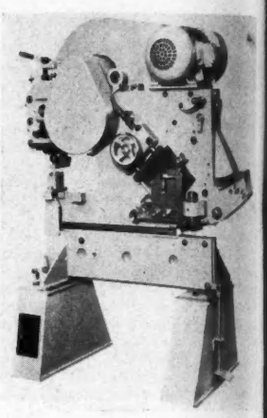
Shears, Punches, Props, and Notches

SHEARING, punching, cropping and notching can all be carried out on the MKC10 Steelworker.

It will shear plates up to ⅜ in thick and flats up to 4½ in by ⅜ in at one stroke. Punching in mild steel is up to a $\frac{13}{16}$ in hole through ⅜ in material or $\frac{11}{16}$ in through ½ in. The rated capacity is 30 tons. It will crop angles and T's up to 3 in by 3 in by ⅜ in and rounds to 1½ in. Square notching can be done in plates up to ⅜ in thick or angles 4 in by 4 in by ⅜ in; the maximum depth of notch is 4 in. Mitre notching is possible up to 2 in by 2 in by $\frac{5}{16}$ in angle with a maximum depth of 1⅝ in. Up to 35 strokes per minute can be made.

The frame of the machine is welded from high tensile plate. The drive from the 2 hp motor to the flywheel is by V-belt and then by spur gearing to the eccentric shafts. Hardened plungers operate on these shafts in bronze bushes and engage on pressure blocks. Both slides may be operated by hand or foot.

The shear blades are interchangeable



and measure 7⅞ in long. The punch is the headed type secured by a coupling nut. Centring is by hand lever or by floating the tool on the work leaving both hands free for positioning. Punch and die can be changed in 4 minutes. *Henry Pels and Company Limited, 32-38 Osnaburgh Street, London, NW1.*

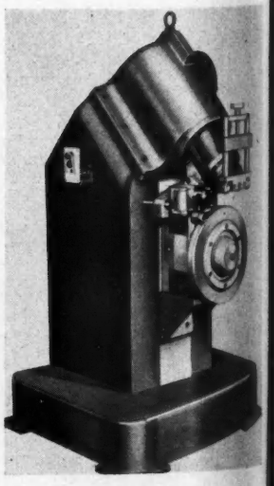
BEVELLER

For Preparing Plate Edges

PLATES both straight and irregular can be bevelled preparatory to welding in the Pullmax model X8 machine.

Speed of operation is one of the features of the machine which will cut at angles of 30°, 37½° or 45°. Four grades of cutter are available to suit the material and the type of joint being made. In addition to plain and irregularly shaped plates the machine will bevel tubes, beams, angles, and inside tubes with radii greater than 8 in.

The cutter drive mechanism runs in an oil bath, power being supplied from an electric motor driving through V belts. There is a choice of two speeds. An adjustable hold-down device prevents tilting of the work and a graduated scale gives rapid adjustment of the main support roller. The machine can be supplied on a pedestal base as shown, or can be suspended from an overhead gantry. This has a travelling crab to allow the machine to progress along the edge of the plate. Alternatively the whole machine can be mounted on



wheels. To ease the handling of large plates, a turntable fitted with a pneumatic lift is available. *Alfred Herbert Limited, Red Lane Works, Coventry*

Scandinavian Survey

NUCLEAR activity in Scandinavia is very much alive. Sweden, Norway and Denmark have their separate Atomic Energy Commissions and the Table (p. 564) shows the investment that each country has put into reactors alone. The Swedish programme is the furthest advanced and has a strong policy for the future. This is due to the shortage of power from their own natural resources so that at present a large proportion is imported. Denmark occupies a tenth of the area of Sweden, has a population of just under a half, and, ironically, imports power from Sweden, among other countries, a fact which illustrates her plight. In Norway the population is about the same as Denmark's but the hydro-electric facilities are more numerous and the need to find another source of energy is not so acute. In Denmark and Sweden, however, the opportunities for nuclear power are high once it has proved itself.

Sweden

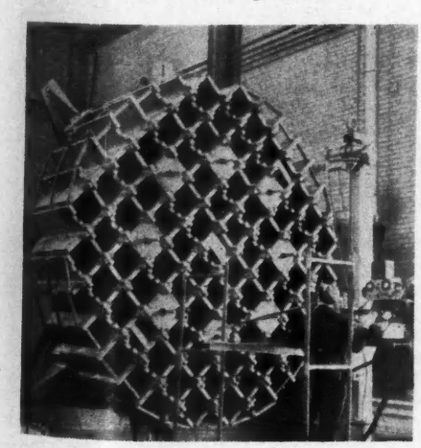
Lack of Natural Resources

There are practically no deposits of coal or oil worth exploiting in Sweden and it is therefore necessary to import about 85 per cent of the coal, coke and petroleum derivatives needed. This figure constitutes about 20 per cent of Sweden's total imports and it is rising rapidly. It entails a large strain on the energy balance and a vulnerable position of fuel imports are disrupted. The resources of water power are considerable and about 95 per cent of the electricity produced comes from hydro-electric power stations. With an annual increase of six to seven per cent in the demand for electricity, within fifteen years there will be no hydro-sites that can be developed at a reasonable cost and additional production will have to come from thermal stations using fossil or nuclear fuels.

Atomic Energy Company

Sweden formed her Atomic Energy Company in 1947. There are three technical divisions: for reactor development, chemical research and production and industrial reactors. In 1960 it had about 1,200 employees of which some 20 per cent were graduates. The company has offices in Stockholm where its activities are at present concentrated, and it also has premises at Studsvik, Kvarntorp and Ranstad (the latter two being uranium mills). A centre is being built at Studsvik where most of the research work will be carried out, including research activities to be moved from Stockholm. The activities of the company, apart from the share capital of 14 million Swedish kroner, are financed by the government. For the financial year 1960-61 the grant for running costs and investments was 118 million Swedish kroner (£8,150,000). This figure is approximately a quarter of the total amount granted by the government in the last 14 years, and amply illustrates the increased interest being given to nuclear energy.

Fig. 1 Welding the grid to the lid of the reactor tank at Ågesta.



Activities of the Company

Since July, 1954, the experimental reactor R1 has been operating in Stockholm and is used mainly for experiments in reactor and neutron physics and for the production of radio-isotopes. From February, 1955, exponential experiments have been in progress with natural uranium and heavy water in a zero energy bare reactor assembly called ZEBRA. The company is responsible for the first industrial prototype reactor being built at Ågesta. It is a combined heat and power reactor station and is being housed in a gas-tight chamber excavated in the rock with the reactor located in a concrete shield. The grid to the lid of the reactor tank is shown in Fig. 1. The fuel elements are made up of bundles of 19 rods consisting of sintered uranium dioxide pellets of 17 mm diameter clad in tubes of zircaloy-2. The bundles are inserted in boxes of zircaloy through which the cooling water flows.

Design work has begun on the first full scale plant for electricity production at Marviken on the Baltic coast, 40 km east of Norrköping. It is hoped to begin the construction of the plant later this year for operation to begin in 1967.

The R-0 reactor is primarily concerned with the determination of the critical volume of various core configurations using different types of fuel elements for future power reactors. The effects of temperature changes and poisoning are also investigated. Since it first went into operation in September, 1959, R-0 has been operating without a graphite reflector and radiation shield, while the power level has been kept at 0·1 W. During this year it is hoped to build in a reflector and shield and the power will be increased to 100 W.

Future Reactors

Investigations for future reactors are being made into the potentialities of the fast breeder reactor system. A zero power fast reactor FR-0 is now in the design stage and it is hoped it will be operational by next year. It will probably have a spherical core with 20 per cent enriched uranium; the core will be surrounded by a copper layer and then a layer of natural or depleted uranium.

A 5·5 MeV van de Graaff generator is now under construction and will be an important supplement to the FR-0. The major private power companies have formed a consortium to develop atomic energy, and the AKK Power Group (Atomkraftkonsortiet Krångede and Co. AB) is now considering constructing a 50 to 60 MW(e) light boiling water reactor.

Development of Uranium Plants

The aim of the Swedish Atomic Energy programme continues to be one of reducing dependence on fuel importing. The activity is therefore mainly directed towards reactors based on the system of natural uranium and heavy water, since both these materials can be produced inside the country. Sweden has considerable uranium deposits but, unfortunately, of poor quality. Uranium is extracted from oil shales at Kvarntorp where the output is 10 tons of uranium concentrate per annum. This plant will later process richer ores. The uranium is refined later in a plant at Stockholm. A larger mill with a capacity of 120 tons of uranium per annum is under construction at Ranstad in south-west Sweden, and will be operational by 1964-65.

Studsvik Research Centre

As mentioned already, the main part of the research and development work will move to the research centre being established at Studsvik. The most important facilities include a 30 MW materials testing and research reactor R-2, purchased from the USA, a laboratory for studying irradiated materials and fuel elements from R-2, an isotope centre, a zero power reactor R-0, and also a laboratory for radiation protection and waste disposal. The ZEBRA installation has been moved here and a pressurised ZEBRA facility is under construction. A zero power reactor R-2-0 with a maximum power of 100 kW has been acquired to complement R-2. It is located in the same pool as R-2 and is used for preliminary studies of R-2 experiments and for shielding research.

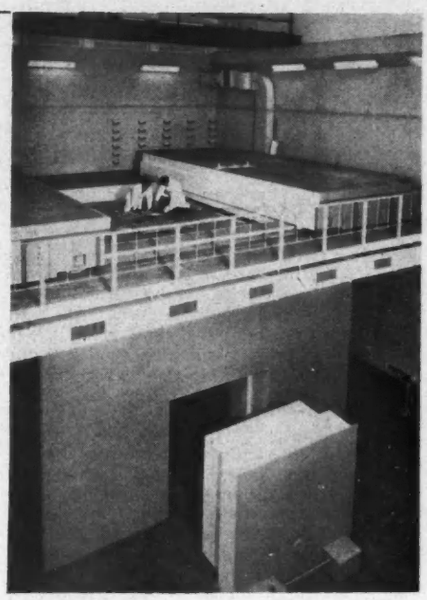


Fig. 2 The zero energy facility NORA at Kjeller due to come into operation in May 1961.

Norway

Off to an Early Start

Norway's need to find some other form of power is not so important as in Denmark and Sweden since she has many untapped hydro-electric sources. In spite of this, a 450 kW research reactor JEEP (Joint Establishment Experimental Pile) was the first reactor outside those of the great atomic powers to go critical after the war. The Institute of Atomic Energy was established in 1948. The main research centre is at Kjeller, 16 miles from Oslo, where there are two reactors and research laboratories.

Netherland Cooperation

When the plans for JEEP were being considered it was thought that sufficient uranium could be extracted from the pegmatite deposit at Einerkilen. However, the Netherlands had some uranium which had been stored since before the war, and in order to utilize this and start in atomic research, the Dutch were interested in participating in the Norwegian reactor project. The negotiations took place in the spring of 1950 which resulted in the Netherlands supplying uranium for the Kjeller reactor, and in return the Dutch were granted full use of the facilities—this agreement continues today. At the end of last year 570 people were employed, of whom 160 were graduates.

Marking Time

The rapid exploitation of the hydro-electric sources will lead to three-quarters of these being utilized by the 1980's. The probable increasing cost of further exploitation of water power will lead to atomic energy entering more into the sphere of power generation. As a leading shipping nation it is felt that nuclear propelled ships may play an important part in her economy.

Plans and specifications for a nuclear propelled tanker are being made at the moment.

Halden Project

The experience gained from JEEP gave rise to prospective plans for an experimental boiling water reactor in 1955. Nearing the completion of the construction of other reactors the European Nuclear Energy Agency (ENEA) of the OEEC embarked on a study programme of prototype reactors, which included the boiling heavy water type. Negotiations between the Institute and the ENEA resulted in an agreement on the joint operation of the reactor and an experimental programme to be carried out in a period of three years—this has now been extended by a year and a half, since the initial programme proved too heavy. The fuel elements for the second core are being delivered from Sweden now.

Building Programme

JEEP II is being built to replace the original JEEP. It is still a heavy water reactor with increased thermal power and flux. Isotope production, which continues to show significant increases, will be extended with the new reactor and a new isotope laboratory has been built for this purpose. In order to assist the reactor experimental programme a zero power reactor assembly, NORA, will come into operation in May. A model of the assembly is shown in Fig. 2. Three new laboratories are being built, and an extension to the reactor school where advanced training is given. Noratam A/S, a private company, which was formed in 1957 to undertake industrial assignments within the atomic energy field has played a great part in the design of JEEP II and NORA.

Denmark

Establishing the Commission

The Danish Atomic Energy Commission was constituted by an Act of Parliament on 21 December, 1955, and entrusted with the promotion of the peaceful use of atomic energy. Previously a Preparatory Commission set up by the government had negotiated and reached agreements of cooperation with the United Kingdom and the United States. These agreements, which concluded in July, 1955, provided the basis for the establishment of a national atomic energy research centre in Denmark. The Commission has since expanded the establishment and is building up future scientific and technical research.

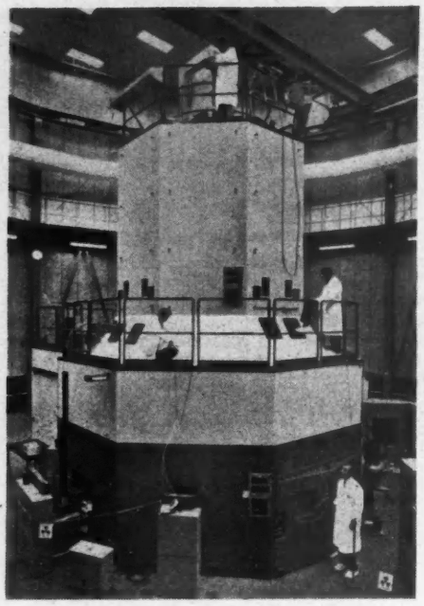


Fig. 3 The 5 MW tank reactor DR2 housed in a gas-tight steel tank.

Risö Research Centre

Construction of the research centre at Risö, 19 miles west of Copenhagen, began in 1956. At present the establishment is chiefly concerned with the design study of an organic cooled reactor with heavy water as the moderator. It has been designated "Dor" and has a thermal output of 300 MW. A linear accelerator purchased from the Varian Associates of California is being installed and will also contribute to the Dor activity.

Three Water Moderated Reactors

Last year the power of DR1 was increased to 2·3 MW. The reactor was examined for chlorine content in the uranium sulphate solution, but no increase was observed. In addition to the irradiation work and investigations on the pile oscillator, a number of courses are held on DR1 varying from instruction courses for students to courses for the operators and engineers on the DR2 and DR3 reactors.

During the period of low power trials several modifications were made to DR2 (Fig. 3) before it finally ran at full power. It also tested 17 different core configurations before full power operation. The reactor is used for measuring cross-sections and irradiation experiments.

The DR 3 has a designed operating range of 1 W to 10 MW. The reactor became critical with 11 fuel elements stabilizing at 5 W but after initial measurements the charge was fully extended to 26 elements.

International Assistance

The Danish Atomic Energy Commission has participated in the OEEC's Halden Boiling Water Reactor Project and the Dragon Project. This constitutes a substantial expansion to the Commission for opportunities in experience and knowledge of other reactor types.

Country	Sweden					
Reactor	R-0	R-1	R-2	R-2—0	Ågesta Heat and Power Station (R-3)	Marvikens Power Station (R-4)
Type	Thermal heterogeneous	Thermal heterogeneous	Thermal heterogeneous	Thermal heterogeneous	Thermal heterogeneous	Thermal heterogeneous
Purpose	Research	Research	Research and materials testing	Research	Heat and power production	Power production
Maximum power	50 W	1 MW	30 MW	100 kW	55 MW thermal } Stage I 10 MW electrical } 125 MW—Stage II	Around 365 MW (100 MW(e))
Fuel	Natural uranium or uranium dioxide	Natural uranium 3 tons in the form of 126 rods	MTR type elements 90 per cent enrichment appr. 5·5 kg U^{235}	MTR type elements 90 per cent enrichment approx. 4 kg U^{235}	Uranium dioxide zircaloy 2 canning	Uranium dioxide zircaloy 2 canning
Moderator	Heavy water	Heavy water	Light water	Light water	Heavy water	Heavy water
Reflector	No reflector or 60 cm graphite	90 cm graphite	Beryllium and heavy water	—	30 cm heavy water	Heavy water
Primary coolant	Light water used to determine temperature dependence	Heavy water	Light water demineralised	Light water demineralised	Heavy water	Heavy water
Secondary coolant	Light water	Air and water	Seawater	—	Light water	Light water
Maximum thermal flux (n/cm² sec)	2×10^8	$3·5 \times 10^{13}$	$2·4 \times 10^{14}$	10^{13}	$4·9 \times 10^{13}$ Stage I 8×10^{13} Stage II	—
Thermal shield	None	None	10 cm steel or 5 cm lead and water pool	None	15 cm stainless steel	—
Biological shield	0·85 m heavy concrete	1·8 m heavy concrete	2·1 to 2·8 m heavy concrete	2·1 to 2·8 m heavy concrete	1·6 m heavy concrete	—
Building	Concrete and aluminium construction	Underground building rock excavation	Gastight concrete hall	Gastight concrete hall	Rock chamber lined with concrete and steel	Pressure-tight concrete or steel containment
Location	Studsvik	Stockholm	Energy Company Studsvik	Studsvik	Ågesta (Stockholm)	Marviken
Present status	In operation since September, 1959	In operation since July, 1954	In operation since May, 1960	In operation since June, 1960	Under manufacture and construction. To be started 1963	Under design. To be started 1967

Country	Norway		
Reactor	Jeep I	II	Halden
Type	Thermal heterogeneous	Thermal heterogeneous	Thermal heterogeneous
Fuel	Natural uranium, aluminium cladding	Natural uranium, aluminium cladding	Natural uranium rods with aluminium cladding. Second core: 1·5 per cent enriched unranium oxide with zircalloy cladding
Moderator	Heavy water	Heavy water	Heavy water
Reflector	Graphite	Heavy water and graphite	Water and concrete
Max. thermal power	450 kW	2 MW	5 MW with first core, 10 MW with second core and 20 MW later
Primary coolant	Heavy water	Heavy water	Heavy water
Max. thermal flux	$1·35 \times 10^{13}$	2×10^{13}	3×10^{13}
Thermal shield	Water	Water	Water
Biological shield			2·35 in concrete
Building			Contained in solid rock
Contractor	IFA	IFA/Noratom	(IFA)
Location	Kjeller	Kjeller	Halden
Present status	Critical in 1951	Completion in 1961	Critical in June, 1959

Country	Denmark		
Reactor	DR 1	DR 2	DR 3
Type	Thermal homogeneous	Thermal heterogeneous	Thermal heterogeneous
Fuel	Uranyl-sulfate in water; 20 per cent enriched; 0·97 kg U-235	MTR-type fuel elements; 90 per cent enriched; 6 kg U-235	MTR-type fuel elements; highly enriched; 3 kg U-235
Moderator	Light water	Light water	Heavy water
Reflector	60 cm graphite	Light water and graphite elements	Heavy water and 30 cm graphite
Max. thermal power	2 kW	5 MW	10 MW
Primary coolant	Light water	Light water	Heavy water
Max. thermal flux (n/cm² sec.)	6×10^{11}	5×10^{13}	10^{14}
Thermal shield	None	5·7 cm lead	10 cm lead
Biological shield	1·2 m heavy concrete (magnetite)	1·6 m heavy concrete (barytes)	1·5 m heavy concrete (barytes and iron shots)
Building	Aluminium construction	Gas-tight steel hall	Gas-tight steel hall
Contractor	Atomics International, Los Angeles	Foster Wheeler Corp., New York	Head Wrightson Processes Ltd., London
Location	Risö	Risö	Risö
Work completed	Completed in August, 1957	Completed in December, 1958	Completed in January, 1960

Companies

Westinghouse Propose New Ethical Code

A "Code of Ethics" for the United States electrical industry has been proposed by the president of the WESTINGHOUSE ELECTRIC CORPORATION. The president, Mark W. Cresap, Jnr., was speaking at the first Westinghouse annual meeting since the recent conviction of a number of United States electrical company executives for anti-trust law offences.

The Westinghouse chief executive described the offences as "a personal challenge to build a philosophy, a policy, a system and a programme of audit and enforcement in Westinghouse which will render impossible the recurrance of such a situation."

The basic problem was not one which could be solved by a single enterprise. Mark Cresap has written to the National Electrical Manufacturers' Association suggesting that they should, on behalf of the manufacturers, draft a code of ethics for the industry.

On behalf of Westinghouse, Mark Cresap told the 2,800 stockholders at the annual meeting that he was willing for the company to subscribe to such a code, which would set out standards of conduct and performance.

Among steps so far taken by the Westinghouse company is the setting up of a new anti-trust section within the company's law department. Since the beginning of the year 32 meetings have been held at which almost 3,000 people with management responsibilities have heard company lawyers speaking on the anti-trust laws and the company's policy.

Doubling Demand

The enforcement programme includes definite disciplinary penalties, an audit system of affidavits and certificates to be signed by any employee attending any sort of meeting where competitors are in attendance, and quarterly reports on enforcement.

Turning to the business prospects of Westinghouse, the president reported that demand for electrical equipment for commercial and industrial construction (up by 4 per cent in 1960) was expected to stay relatively high as construction and modernization programmes continued to provide support for the economy.

American utilities are expected to double their present plant capacity over the next ten years. Put another way, this means they are preparing to provide the power for another United States.

Residential consumption of electricity in the United States is expected to increase by two and a half times in the same period and the Westinghouse forecast is that electric heating will take a growing share of the market.

One way of securing as good or better a share of this market is the introduction of new products. During 1960 the company brought out more than 100 new products, among them a thermoelectric suit to keep its wearer in a steady temperature between 70 and 80° even though outside temperatures varied from 40 below to 135° above zero. There is also a thermoelectric wall panel which it is hoped will one day light, heat and cool the home without the use of moving parts.

A new system of communications has been devised for outer space, it depends on the use of ultraviolet light signals. By the Westinghouse Astacon tube, which electronically brightens an image several thousand times, it is possible to see deeper into space by brightening the light from distant stars.

South Africa the Workshop of the Continent?

It may be that South Africa will decide that some modification of her present policy is preferable to jeopardising her chances of becoming the main workshop and supplier of the rapidly developing continent of Africa. This suggestion is put forward by Mr. W. E. Ogden, chairman of the DELTA METAL Company, who have linked their South African interests with those of MCKECHNIE BROTHERS through the two companies' subsidiaries.

Since only 5 per cent of the Delta group's total capital is invested in the Union, even if conditions there deteriorate seriously it will only have a very limited effect on the company. If South Africa should become the workshop of Africa then with their companies direct connections with the building and constructional trades, the prospects for this part of the Delta company's activities will be highly promising.

In the United Kingdom, Delta hold a 50 per cent interest in JAMES BOOTH ALUMINIUM with the KAISER ALUMINIUM CORPORATION of America. Apart from minor delays the construction of the new James Booth mill is going well and it is expected to be in operation at the end of the year.

Two important additions to the group have been the largest ball valve manufacturers in Britain, C. H. EDWARDS, of Millfields, near Wolverhampton, and SPERRYN and Company, of Birmingham and Cannock, Staffordshire, who provide brass fittings for the gas, electrical and water industries. Both companies have built up substantial export sales.

Group profit before tax for the year increased to £3,776,000 from the previous year's £2,879,000. The Delta chairman, attributing these results to the policy of rationalisation and development begun years ago, suggests that the company may now be entering one of those periods when a considerable amount of spadework has to be done with little immediate gain to be shown for it.

Substantial Improvement in Birfield Half Year

One of the companies who have the useful habit of issuing half yearly statements of how things are going are the BIRFIELD Group. Their results for the six months up to 31 January show a sharp increase in the trading surplus—an improvement of 50 per cent. The figures in the company's table are calculated before providing for taxation or reserves for the increased replacement cost of fixed assets.

Birfield Six Months Results

	To 31 January, 1961	To 31 January, 1960
SALES 6 months	£14,045,000	£11,988,000
NET TRADING SURPLUS 6 months	£1,541,000	£1,013,000

Mr. Nehru at Durgapur

This silver replica of a mill housing, part of the rolling mill plant of the Durgapur steelworks, West Bengal,

was presented to Mr. Nehru, Prime Minister of India, at his first visit to the British-built £120 million steel plant. During the visit Mr. Nehru started up the rolling equipment in the 24 in section mill which is to supply structural products including channels, joists, rails and fish plates.

Durgapur is being built by ISCON—the INDIAN STEELWORKS CONSTRUCTION Company—a consortium of 13 major British engineering companies.

Steady Attrition of USA Profit Margins

Despite a 4 per cent increase in last year's volume of sales the operating income of the United States DU PONT DE NEMOURS chemical company fell from $288 million to $249 million.

The value of the year's sales rose by 1 per cent to $2,143 million, from $2,114 million in 1959. The decline in earnings over the year is ascribed by the Du Pont annual review to the pressure on prices (the company's selling price index was 3 per cent down on 1959) and to steadily rising costs.

Net earnings from operations fell 14 per cent from the previous year while at the same time the average operating investment rose by 7 per cent. This brought the ratio of net earnings to operating investment down from 10·5 per cent to 8·5 per cent in 1960.

Over the last few years the large construction programmes of the chemical industry have produced an excess of manufacturing capacity over current market demand in most product lines, particularly, Du Pont point out, in the older well-established products. Although there have been adequate sales the price structure has caused "profit erosion" not only for Du Pont but for the chemical industry overall.

Rigorous efforts at improved operating efficiency are being made and wherever feasible automatic controls an electronic data processing are being adopted. The savings made in this way should bring down costs and when a future rise in demand brings output closer to capacity enlarge the present narrow profit margins.

Meantime support for research is being maintained and strengthened. On new plants, modernization and increased capacities are existing plants, $214 million were invested last year, against $174 million in the previous year.

The overseas business of Du Pont companies including foreign affiliated non-consolidated concerns reached $363 million. Of that total 35 per cent was in Europe, 28 per cent in Canada, 24 per cent in Latin America, and the rest elsewhere. The total was 21 per cent up on 1959. For the chemical industry of the rest of the world one of the most significant aspects of Du Pont's activities was the 28 per cent increase in the export of its American made products—to a value of $218 million.

CIBA Coordinate their UK Activities

CIBA UNITED KINGDOM Limited, a company with an authorised share capital of £3 million, has been formed by CIBA Limited, of Basle, the pharmaceutical concern.

The new firm will act as the holding company for CIBA's interests in Britain by acquiring from the Basle company the issued share capital of its three wholly owned United Kingdom subsidiaries. The three British companies are CIBA LABORATORIES, making pharmaceutical products, CIBA CLAYTON, selling dyestuffs, and CIBA (A.R.L.), manufacturers of synthetic resins and adhesives. The controlling interests, held by CIBA, Basle, in the dyestuff manufacturers, CLAYTON ANILINE Company, will also be bought.

Dr. Dr. h.c. R. Kappeli has been made chairman of the holding company and Sir Arthur Vere Harvey, M.P., is the managing director.

German-Scottish Electrical Agreement

BRUCE PEEBLES, the Edinburgh engineers, have reached agreement with REGA BRUCKER and Company, of Siegburg, Germany, for the joint production and sale of complete electrical equipment for operation and control of ferrous and non-ferrous hot and cold rolling mills.

Both companies enter the agreement with a long background of experience in designing and manufacturing electrical equipment incorporating advanced techniques in the field of specialized rolling.

The joint agreement covers the supply of equipment in the United Kingdom and Eire. Rotating machines and rectifiers are to be built by Bruce Peebles. Electronic controls, programming, optimisation and automatic gauge control equipment will be designed by Rega Brucker and made by them, or under licence by Bruce Peebles. Several rolling mill contracts are already in hand.

Plant Makers Reply to Users' Criticisms

To step up the exchange of ideas between users and makers of engineering plant, ENGINEERING has conducted a national survey. Two special articles have resulted. Last week's gave comments from users about improvements needed. Today's article brings forward the first replies received from manufacturers.

THERE are more users than makers of plant at the Marine, Welding, and Nuclear Energy Exhibition at Olympia, London. What improvements are the users looking for? What new functions would they like equipment to fulfil? To find the answers to these questions, ENGINEERING got in touch with 15,000 engineering firms. Their comments on the plant they use or could use were published last week as a special article, p. 522.

A pre-print of the article was sent to the manufacturers taking part in the present exhibition. Enclosed with it was a questionnaire inviting their comments on how users' requirements could be met.

Replies from manufacturers are summarized below, under the same headings used in the first article. The detailed consideration given by many of them to the requirements of users is very much appreciated. Where permission to quote has been given, the manufacturer's name is recorded. As these firms are all exhibitors, it is hoped that the readiness with which they discuss users' interests will encourage visits to their stands for continuance of the discussion started by these two articles.

Comparison of the number of comments by users with the number of manufacturer's replies, section by section, shows a certain lack of balance. For example, users were critical of electrical components and made a large number of suggestions, none of which has so far been answered by a maker. Alternatively, answers to comments on welding equipment were very full indeed. This arises because of the selective nature of the exhibition. In the case of electrical equipment, it can be assumed that firms in the best position to reply to the comments would be found, not at this exhibition, but at the recent ASEE Electrical Engineering Exhibition.

All Plant

As far as plant in general was concerned, many manufacturers were willing to give their views on costs, standardization, and delivery dates. The more specific points such as quality of finish, reliability and guarding of danger areas were not taken up. A constant theme running through the replies was the danger of reducing prices by lowering quality. A blunt comment in reply to the request for reduced prices came from one machine tool manufacturer. "Quality and service must not be sacrificed in achieving lower costs. It only brings dissatisfaction to both sides."

Price, delivery dates, and standardization were commented on by the Turbine Generator Division of AEI Limited. It is fairly typical of replies received. "With regard to price, it is of interest that some leading electrical manufacturers have recently announced lower profits despite increased orders. Like most manufacturers we are well aware of the importance of cutting down delivery times and keeping to promised delivery dates. A good deal of thought is given to this problem and so far as is practicable the division holds stocks of machined components of standard small turbine and generator frames."

The need for increased standardisation, suggested by some users, was vigorously disputed by Martonair Limited, who consider that the present state of affairs has the advantage of offering the user a choice from a wide variety of equipment. "Opportunity for selection could be greatly reduced if standardization were rigidly imposed. Standardization could well lead to stagnation and under no circumstances would we agree to confine ourselves to the manufacture of a limited range of equipment."

The solution to the dilemma of obtaining standardization and variety was suggested by Mr. C. G. Delforce, sales manager special products, Glacier Metal Company Limited. "One constantly recurring subject is that of cost and of the effects of standardization upon cost. We feel this can be extended to include standard components in non-standard and standard machines. This company offers an extensive range of standard bearings available from stock. If designers made greater use of these standard bearings when designing plant, they would benefit both cost-wise and in delivery when compared with "specials," often only slightly different from a standard part."

Mr. Delforce also had an answer for the request for centralized powered lubrication. "In many of these applications Glacier Dry Bearings would do the job, as indeed they are, and their employment would not only reduce maintenance but greatly simplify design and show marked savings in cost."

In some cases manufacturers saw no need to reply, and said so. To quote one such answer received: "I feel myself, it [i.e. the type of plant produced by this manufacturer] is a subject rather on its own and could provide the matter for a separate article but I would feel it necessary to restrict criticism to more specific detail than better delivery, better prices, better quality—terms which seem to appear in your first general article."

Others found they could not reply to the users' comments. The representative of one large firm wrote of the article: "I circulated this among interested parties and it would seem that they consider themselves not in a position to provide you with any relevant material, so I have not returned your questionnaire, I am afraid."

A problem voiced by a number of manufacturers was the difficulty in making new products known: several user firms had voiced requirements for products that, unknown to them, were readily available from certain manufacturers. The problem was one of communication. The situation was clearly put by Mr. E. N. Addison, managing director of the Addison Tool Company, and although his reply refers to cutting machines it is worth quoting it here, as it has much wider relevance.

"Your article is of interest to us as specialist suppliers of circular sawing machines for metal. Paragraphs 4, 8, 16 and 29 under the heading of "Machine Tools" referred to such machines, and I can only wonder how these firms could have missed the write-ups appearing in the technical press (including your own of course) on our Sawing Machines. As they have taken the trouble to fill in your questionnaire we presume that an effort was also made to locate likely suppliers.

"Many buyers of machine tools rely on the merchant trade to keep them informed of the latest developments, and every engineering firm in this country is probably visited by representatives of the machine tool merchant at more or less regular intervals. As a specialist firm however, we can never hope to cover the whole country and meet all our potential customers. We rely therefore for our contacts on write-ups of our machines in the technical press, such as yours—which is extremely helpful—on annual directories where our name appears in the appropriate section, and in addition on the recommendation of customers to their friends now that circular sawing machines for metal have become the accepted method for cutting off.

"It would therefore appear that the obvious method would be to sell our machines through the merchant trade, but this is where difficulties arise which prevent the user of such machines, or at least some of the many small users, from having a really up-to-date tool. The merchant will only stock safe sale machines he knows have been proven on the market before, and where demand is assured. He will not risk a new type of machine (new type meaning less than five years old) which would raise the amount of capital tied up in stock, and his representative would have to get to know the technicalities of yet another machine. His interest, therefore, is in keeping his customers supplied with established types where no selling effort is necessary, which tends on the other hand to keep his customer's workshop old fashioned, out of date, and inefficient.

"Personally, I feel therefore that most of the user's complaints in your article are due to one or other of the points mentioned above, or even a combination of any of them.

"The solution? A more open and enquiring mind on the part of the personnel responsible for buying the machinery, and a broader outlook from the merchant in trying to give his customer the best machine for his work, not necessarily the one he has in stock and has known for the last twenty years or so."

Another form of reply was as follows: "We enclose a copy of our current leaflet describing our boilers and feel sure this will be the best answer to your questionnaire." Interesting as the leaflet was it made no mention of any of the points raised by users of boiler plant, although the general profusion of superlatives might be considered as the appropriate retort for a request for "overall improvement." Only a small number made such replies but if it is assumed that manufacturers not replying at all had a similar indifference to the users' requirements then there seems some justification in the users' comment: "In general we have found that British manufacturers are not interested in building one-off machines or even in modifying standard types to meet special needs."

Such lack of interest, however, was not shown in the reply from Sciaky Electric Welding Machines Limited. Mr. R. H. Jordan, sales manager, writes: "We are most surprised to see under reference 15 that a potential user of welding equipment complains that British manufacturers of such plant are not interested in building special purpose machines." He then goes on to describe specialist machines produced to order, as detailed in the "Welding" section. He adds, "We make these observations as a member of the largest group of resistance welding manufacturers in the world, and would add that we shall be most pleased to receive further comments from user companies on their requirements, and will, of course, make every endeavour to meet them."

Boilers

The demand for overall improvement voiced by users in this section was commented on by Mr. W. A. Smith, NIFES. "Among the cases of 'overall improvement' there is an apparent paradox in the hesitation with which the solid-fuel-fired packaged unit is currently regarded. While nearly all consider this type of improvement to be desirable, do we indeed need to envisage further financial backing to secure a more rapid acceptance of progress?"

Besides putting a measure of responsibility for the state of plant design on the users of plant, Mr. Smith's comment raises the wider question of how progress in design can be made known and accepted more rapidly. Very few

manufacturers touched on this point in their replies, yet it must affect every one of them considering improvement of his product. When does the cost of making known a product make production uneconomical? When does a product become sufficiently important to the national economy to merit financial backing from the Government? How much should user-industries pay to find out about new products?

Diesels

Although comments from diesel users were few, many manufacturers were ready to give detailed answers to them. The problems of noise and vibration were dealt with from several points of view. One manufacturer wrote as follows. "More power in less space is a continuous demand with modern machines and this leads to lighter and higher speed diesel engines with inertia forces which are, consequently, of greater magnitude and frequency. The machinery makers can help to offset this by considering the engine application at the time a new machine is being designed, and by cooperating with those engine manufacturers who offer a service to the machinery maker in this respect. The customer who is prepared to pay a little extra for a quieter running engine with more efficient inlet and exhaust silencers will help in the provision of a machine which is more silent and smoother in operation."

The situation in automotive applications was commented on by Mr. G. R. Guest, manager of the industrial branch of Perkins Engines Limited. "The demand for increased driver comfort has encouraged engineering plant manufacturers to make efforts to reduce vibration and noise.

"If the machine is to remain competitive, the manufacturer must carefully consider cost. Freedom of engine movement is an essential feature of design if a flexible mounting is to be successful, and in addition to the cost of the mounting, flexibility may also involve some redesign of the machine which will probably increase manufacturing costs as compared with a solid mounting.

"All moving parts of a high speed diesel engine are manufactured to very close limits, and provided the driven machinery is of sufficient strength to absorb the forces emanating from the engine, very little vibration will be transmitted to the operator.

"In some heavy machines, such as shunting locomotives and road rollers, a solid mounting is still favoured, but in the lighter machine vibrations can be magnified and the problem is complex.

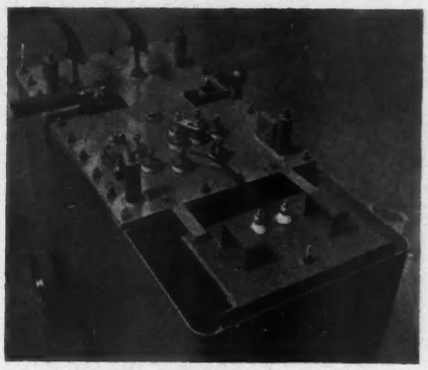
"Many manufacturers have found that there is a little more involved in solving vibration and noise problems than 'putting in a piece of rubber.'

"Full cooperation between plant manufacturer, engine maker and the anti-vibration mounting specialist can go a long way to the complete elimination of objectionable vibrations, and as some noise is associated with vibration, the introduction of flexible mountings will result in an all round improvement.

"Some countries have also introduced legislation to limit noise levels for machines used on highways, and diesel engine manufacturers are making every effort to reduce noise to the lowest possible level."

"Some manufacturers were satisfied that it could not be *their* diesels that were commented on by the users. One wrote "We think the remarks under the section 'Diesel Engines' do not strictly apply to the types of engine we manufacture and we should, therefore, like to be excused from commenting in this instance." Another, who made diesels for use in their own equipment, decided that comment would not be appropriate.

W. H. Dorman and Company Limited noted the lack of criticism from diesel users: "The comments with regard to diesel engines are apparently few in number, from which it could be reasonably assumed that users of diesel power are a race of generally satisfied customers.



300 A single operator portable ac welding equipment with built-in power-factor correction capacitor (top cover of unit removed).

This is not surprising as diesel engines, according to their usage, have been rapidly developed to an advanced stage of reliability, efficiency and economy in operation and maintenance.

"With any reciprocating type of machinery some degree of vibration is inevitable. In diesel engines of current design vibration is reduced to the minimum by means of statically and dynamically balanced crankshafts, balanced connecting rod and piston assemblies and so on. Vibration can be, and is, more or less eliminated by the use of efficient and effective anti-vibration mountings, and Dorman Diesels so mounted have proved thoroughly satisfactory.

"The noise level can be satisfactorily dealt with by means of silencers and/or sound insulation. Here again Dorman diesels are satisfactory when used in hospitals, hotels, residential areas and the like."

One comment made by a user referred to all types of engine, namely, that they should carry plates indicating which oils should be used for particular applications. The difficulty in doing this was pointed out by both Perkins and Dormans. "Oil tally plates are a good thing from the operator's point of view," commented Perkins, "but the engine maker may be supplying engines to plant manufacturers for despatch to upwards of 150 overseas territories. Brands of lubricants are not universal and with the language problem and wide ambient temperature range to be covered, the engine maker may approve some 20 or 30 lubricants on a world wide basis.

"As the engine maker may not know the ultimate destination of his product when it leaves his factory, all the brands of lubricant would have to be shown, and if the tally plate is to be readable, it becomes too large to be accommodated on the engine.

"Many plant manufacturers, however, solve this problem by placing a lubricant chart in the appropriate language on their machine and include the engine lubricant recommendation."

A similar comment came from Dormans. "As we supply diesel engines to a number of the oil companies at home and overseas it would be "infra dig" for us to specify one brand and make to the exclusion of others. Further we find that users often have their own preferences for various reasons. Again, some brands and marks may not be readily available in some overseas territories. Also, diesel engine makers have to bear in mind questions of ambient temperature on site (variable at different seasons of the year), sulphur content of fuel, S.A.E. classification number, whether straight mineral or detergent oils required, etc. To meet these various relevant points we find it highly desirable to include in our handbooks a comprehensive list of recommended lubricating oils for Dorman Diesels.

"Users of our engines can then satisfy their own preference. These recommendations are also available on a separate sheet as specimen herewith. The recommendation also covers greases."

Finally, a comment on the dangers of price cutting came from Mr. W. G. Richardson, director, Intermit Limited. "We would point out that the users of these engines can frequently cause rapid wear of them by not insisting on both air and oil filtration equipment to the specified standard. Our experience has shown that, due to competition and price cutting, suppliers of diesel engines are frequently forced to install inferior filters that allow contaminants to pass into the engine and can cause expensive replacements within a short period. More efficient filtration at a slightly increased initial cost would overcome this and can greatly reduce maintenance costs."

Compressors

One of the main points taken up by manufacturers in this section was the request for moisture-free and oil free air from compressors. Mr. W. G. Richardson (director, Intermit Limited) pointed out that the fault was often with the users, who did not always make clear what they wanted. "We feel that users of compressors should be asked to specify more accurately the cleanliness required in the air systems. This would be of use both to manufacturers of compressors and to the manufacturers of air filters suitable for these units, particularly since two forms of contamination can become apparent: first, a compressor working in a dirty atmosphere can draw in dirt causing rapid wear of the compressor and passing the dirt on through into the compressed airlines. Similarly the moisture in the atmosphere and oil used for lubricating the compressors can cause excessive contamination of the compressed air."

Broom and Wade Limited pointed out that they supplied compressors delivering oil free air, "now so much in demand in various operations."

Glacier Metal Company Limited revealed that work was in hand on a new range of oil-free compressors. "Although it would be wrong to mention names, we are actively engaged with certain manufacturers in the design and testing of "all dry" compressors incorporating the range of Glacier Dry Bearing products in a number of conventional and unconventional applications, and it would appear very likely that such compressors will be on the market in the not too distant future."

Wade Engineering Limited suggested that several of the users contributing to the section would find that Root's-type superchargers would meet their needs. "Oil free air delivery is one of our major claims and this has been borne out by the film industry where oil in the air stream can just not be tolerated at all." In answer to the request for an oil free delivery to agitated water rinse baths after electroplating, the company pointed out that their superchargers have been used in the agitation of liquid baths during the oxidization of chemicals "where oil free air is absolutely essential."

Root's-type superchargers were invented in 1859 and can deal with quite high mass flows of air. Their working pressure, however, should be limited to 10 lb per sq. in in a single stage. In answer to the request for a centrifugal compressor or a non-lubricated sliding vane rotary compressor for steam, capable of increasing the pressure by 5 lb per sq. in, the company point out that the Root's type is suitable for this pressure rise and, if properly designed, is quite capable of handling steam.

The company produce a range of standard units in the following sizes: ¾, 1, 1½, 2, 3 and 6 litre swept volume per revolution. These are produced as stock lines and small quantities are usually available from stock. Non-standard superchargers can be designed for particular application, "and,"—say Wade to potential non-standard customers—"given reasonable quantity requirements, we can assure you of an economic price."

The commonest complaint from users of noise and vibration in compressors has not so far been answered by any of the manufacturers.

Hydraulic Equipment

The question raised by one user as to the availability of a fork-lift truck having a hydraulic stop valve to limit the lift when working in limited headroom was taken up by two manufacturers. "This company is always ready to fit a microswitch to cut out hydraulic flow at a given height for use on mezzanine floors, etc." wrote one, who preferred their name not to be quoted.

Lipton Products Limited wrote and explained that they have produced an attachment for fork-lift trucks which enable pallet loading heights to be preselected.

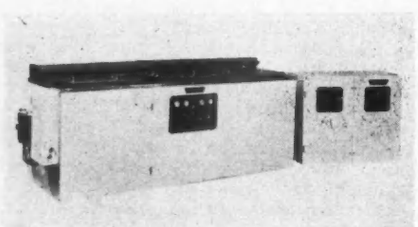
Called the Autostack, the new patented device enables the forks to be set for loading or unloading to any number of predetermined pallet heights automatically, simply by pushing a selection button and operating the lift valve lever, which is held electrically until the selected height is reached. It consists of three components: an adjustable position sensing attachment on the truck's mast, an electromagnetic lock attached to the existing hydraulic lift valve and a push button selection unit.

Pneumatic Equipment

The questions raised in this section were dealt with point by point by some manufacturers. In reply to a request for an extension in the range of miniature fittings, Martonair Limited replied: "Martonair supply fittings for $\frac{1}{8}$ in outside diameter tubing, which is small enough for most applications." To the statement deploring the tendency of certain companies to discontinue particular "lines" and spares, which forced customers to accept new and not always better "lines," the reply was: "As far as we are concerned, spares for old type equipment are always available. New types of equipment are deliberately introduced from time to time to keep pace with modern developments and users' requirements. Martonair certainly would not wish to continue to produce equipment which had become outmoded." The company's view on standardization is mentioned in the section on all plant.

To the request that small pneumatic presses should have a built-in safety device to obviate the need for outside guards which tend to obstruct operation, Martonair point out that they market a Two-hand Safety Control specifically for this purpose. As to the demand for a reliable and sensitive unloader valve in connection with pneumatic timer circuits, "We can see no real problem here," write Martonair. "Insufficient data is stated to provide a complete answer, but Martonair have available, as standard, reliable pneumatic timers with a repeat accuracy within $\pm$ 1 per cent."

The request for the development of small compressed air motors, suitable for replacing electric motors, brought forward the suggestion from Wade Engineering Limited that the Root's type of machine gives quite a good account of itself as an air motor for certain specialized applications. "It is ideally suited for replacing electric motors in conditions where high temperatures prevail. It has a high starting torque, is instantaneously reversible, has an infinitely variable speed range and is dependent on pressure alone, being independent of the density of the working fluid. It does not, however, make use of the expansive commodity, and therefore such air motors should only be used in locations where extenuating circumstances preclude the use of alternative types of motors.



A typical three-stage ultrasonic cleaning cabinet. It uses 4 kW at 40 kc/s.

Electrical Equipment

While the section on electrical equipment was a popular repository for comments by users, it has so far drawn little response from the makers A comment on the suggestion of back-pressure turbines for power supply to arc furnaces came from the Turbine-Generator Division of Associated Electrical Industries Limited. "The reference in the electrical equipment section to use of back-pressure steam plant is not very easy to follow. Such plant is only appropriate in industries where there is a requirement for appreciable quantities of low pressure steam for heating or processing. In many installations the question of agreement with the electricity authorities does not arise as the generators do not operate in parallel with the public supply."

Conveyors

The comments by users drew no reply from conveyor manufacturers. The Glacier Metal Company, however, were able to suggest a solution to the problem of conveyors suitable for phosphating plants. They point out that Glacier DU is "now being employed on an ever increasing scale in this and other similar applications, because these bearings do not have to be protected from the environmental conditions."

Welding

The welding section was the most popular for comments from manufacturers, the replies being detailed and interesting. In fact, all the comments raised on non-automatic equipment received answers—except one, and in this case no reply constituted the answer. Comments drawing most replies were requests for improvements in welding aluminium, for an ammeter on the output side of welding plant, and for a built-in power-factor corrector for a welding transformer. The request for a really effective continuous wire-feed hand welding gun also brought in a high proportion of replies.

The fact that a potential user of welding equipment should complain that British manufacturers of such plant are not interested in building special purpose machines surprised Sciaky Electric Welding Machines Limited. They wrote: "We can assure your contributor that an extremely high percentage of our production concerns 'tailor made' equipment, which is only supplied on a 'one off' basis. Every current motor passenger-vehicle, for example, is produced by a number of special resistance welding machines which are specifically designed for the model and cannot be used on other applications. Further, one of the present trends in resistance welding is for the design and production of multiple-head machines which embody other processes, such as forming, broaching, etc., and could not possibly be used on any other work than that originally conceived. Inevitably such machines are supplied as a single order and repeat orders are the exception rather than the rule."

On the topic of welding aluminium, Mr. E. Christie, welding engineer, Suffolk Iron Foundry (1920) Limited, pointed out that four methods are in general use for welding aluminium: gas torch, argon arc, metallic arc, and electrical resistance. "It is important to select the appropriate method according to type of joint required, volume of welding on hand, quality of aluminium or alloy, and economic considerations. With every method it is important that the operator shall be well skilled in the use of the plant and acquainted with the characteristics of aluminium. Weldability of aluminium is very good and first class results are obtainable every time if consideration is given to the conditions outlined above."

The welding of aluminium is clearly a matter into which many considerations enter, and this was the tenor of several of the manufacturers replies. As the Arc Manufacturing Company Limited pointed out: "Information as regards the welding of different types of aluminium is readily available from the British Welding Research Association."

Sciaky suggested that the biggest advance in welding of light alloys was the use of three-phase balanced-load equipment, "which not only provides a special 'tailored' secondary wave shape, but also enables extraordinarily high secondary current to be developed from machines having a modest mains demand spread equally over three phases. Most British aircraft utilise light alloy components spot welded by three phase plant, and in particular all Class 1 structures on the 'Victor' bomber are fabricated by Sciacky three-phase light-alloy welders. The main difficulty which previously existed on the welding of light alloys was the lack of sufficient secondary current to effect a weld *quickly*. The above plant overcomes this."

With regard to the request for a light socket on portable welding plant, Arc Manufacturing write: "Portable welding plant complete with portable lighting non-standard items can be fitted to most portable welding plants, at extra cost, invariably on site. Other forms of generating equipment are available without the necessity of tapping of the welding generator."

On the same point, English Electric Company Limited remind us that this is something they have done in the past.

The request by one user for an ammeter on the output side of welding plant met with a varied response. Arc Manufacturing wrote: "On welding generators this is a standard item. On welding transformers, the current scales are sufficiently reliable, eliminating the necessity for ammeters, but these can be fitted at a small extra cost if required."

Sciaky wrote: "We are not sure whether this comment refers to resistance welding plant, but we can state that it is perfectly practicable to couple an ammeter on the secondary or output side of the resistance welding transformer fitted to spot, seam, and projection welders, etc."

English Electric did not favour the idea of fitting an ammeter to the output side of welding plant. "We regard this as bad practice, because: (*a*) on well constructed equipment the current calibration shown on the current marking plate should be within $\pm$ 5 per cent and consequently will have the same degree of accuracy as a commercial current-transformer operated ammeter; (*b*) when an operator is welding, he should be concentrating on his job and not looking at the ammeter on the welding equipment; (*c*) ammeters mounted to welding equipment frequently suffer damage which renders them inaccurate, if not completely smashing them; (*d*) we consider the checking of output current by a second man with a long test ammeter as being the correct way to check welding current."

Two companies were willing to fulfil the request for a built-in power-factor corrector for a welding transformer (200 to 300 A oil immersed); a third offered a transformer that in certain circumstances did not need correction. The complete range of single and multi-operator welding transformers produced by English Electric are available with built-in power-factor correction capacitors.

Portable Welders Limited wrote in answer to this query as follows. "The Fararc 240 series III toroidally wound arc welder has a lagging power factor varying between 0·8 and 0·9, the latter being obtained on heavier gauges of electrode. This has been approved by a number of electricity authorities for connection to rural mains without the fitting of condensers. The design has the additional advantage of extremely light weight, the unit weighing only 90 lb yet having a continuous output of 200 A and a maximum output of 300 A. It is built to

Class H insulation and has fan cooling." Although this is a different transformer to the one the user asked for, it might well suit him, depending on where he uses it.

Only one firm replied to the request for "welding equipment for use on galvanized tube with simple and mobile fume extractor." Arc Manufacturing wrote: "No serious comment, except that it is a comparatively easy matter to use a flexible tube, 8 in diameter, fitted with an exhaust pipe." The request for an electrode for welding 70/30 brass to mild steel was also answered by this company, who suggested their Bronzarc/Black electrodes. The British Federal Welder and Machine Company were willing to supply spot welding equipment for this application.

To the user requiring good copper welds, Arc Manufacturing wrote: "sound welds can be made in various grades of copper provided reasonable precautions are taken so far as preheating is concerned, and the correct filler wire is used with a suitable power source recommended for argon-arc welding." To the request for welding equipment for the argon arc welding of light stainless steel components the company replied that they made suitable equipment.

For the same application, Mr. E. L. Courtney, managing director, Interlas Limited, pointed out that "Interlas can supply the Miller SR 15 welder specially designed for paper thin materials to be argon arc welded at an output of 1½ to 15 A, and the Miller "Aircrafter" with an output of only ½ A up to 300 A."

Nobody took up the challenge to produce a less cumbersome hood design for argon arc plant. Three manufacturers, however, commented on the request for a spot welding machine capable of producing a weld without marking on one exterior face. Portable Welders wrote: "For all our spot welding guns, both of a maintenance and a production nature, we have a floating ball and socket electrode, which enables one to produce a spot weld without marking on one exterior face." Sciacky, too, had a system for avoiding marking: "Virtually mark-free spot welds can be produced on 20 swg clean mild steel sheet, providing the special low inertia pressure head, operating in contunction with synchronous electronic timing giving one-cycle weld pulses, is used." British Federal Welder and Machine said they could supply the right sort of machine for this job.

The last company also pointed out that they could supply electrode tips that did not pick up aluminium and require frequent cleaning, although they did not say whether they were the copper tips requested by the user. Sciacky say they can supply "White Spot" electrodes, "ideal for welding light alloys." But they point out that it is not necessarily the tips that are at fault if "pick-up" is occurring. "The prime cause of pick-up when joining these materials is due (*a*) to overheating to the electrode due to insufficient water cooling; (*b*) incorrect rake angle or electrode form; (*c*) surface oxide on the aluminium component which should be removed by abrasive or chemical cleaning agents prior to welding".

Three companies offered to supply the user who asked for inexpensive and reliable current and time controllers for fitting to existing machines. Sciacky offered a self-contained timer unit at £25. Portable Welders offered electronic timer-contactor units: "Our Mark III time-contactor costs £42 10*s* and is built for controlling single-phase 200-250 V resistance welding equipment. Our Mark IV timer-contactor at £50 uses the same timing control on a 100 A heavy duty contactor to take 400/440 V supply." British Federal Welder and Machine said they could supply the equipment requested, but did not give details.

Portable Welders were also able to answer the request for "resistance welding equipment (spot welding) for medium and small sheet metal work—portable type, possibly powered from existing static equipment." They write: "This query fits in exactly with our complete range of portable and competitively priced spot welding equipment for medium and small sheet metal work. The guns are essentially portable, but can be mounted on a pedestal stand where small work is involved. We do not believe the idea of powering equipment from existing static machines is really practical, as extremely heavy secondary cables would be required, whereas in our guns the transformer is built right into the equipment. Our guns range in price from £48 for a small maintenance machine to £374 for a continuous production automatic machine."

To the request for flash butt welding equipment for joining rectangular tubes $\frac{1}{16}$ in thick with complete freedom from pin-hole, British Federal Welder and Machine replied that they could supply the equipment. Sciacky could too.

Finally, the comment on damage to welding cable due to flexing where the cable entered the electrode holder was taken up by Interlas. They explained that they supplied super flexing welding cable which can be tied in knots quite easily without any question of damage to the cable. Whether this is the complete answer to the user's problem is not clear. The best thing is to flex it and see.

The request for an attachment for automatic adjustment of the height of the nozzle during flame cutting, to allow for unevenness of the plate, drew a response from Hancock and Company (Engineers) Limited. The company have been manufacturing equipment for this job for several years.

It is made up of a small electronic control unit fitted into a sheet metal case, mounted on the top of the machine. Attached to this by electric cable is a remote hand control switch box with clips on the back so that it can be placed anywhere along the burner bar. The remote switch box has one switch for each burner which either raises the burner to its maximum height or alternatively lowers the burner until it senses the height of the plate. When the switch is in the automatic position, the burner will maintain a constant height above the plate.

The burner itself is raised and lowered by a small fractional horse power motor that is connected to a lead screw in a totally enclosed mechanism attached to the vertical slide on the machine. A coaxial cable runs from the control box to the circular ring round the bottom of the nozzle, and it is the capacity variation between this ring and the material beneath the burner that, through the electronic control circuits, causes the motor to revolve in one direction or the other to raise and lower the burner.

The unit can also be used for bevelling up to 45°. Its cost is about £155.

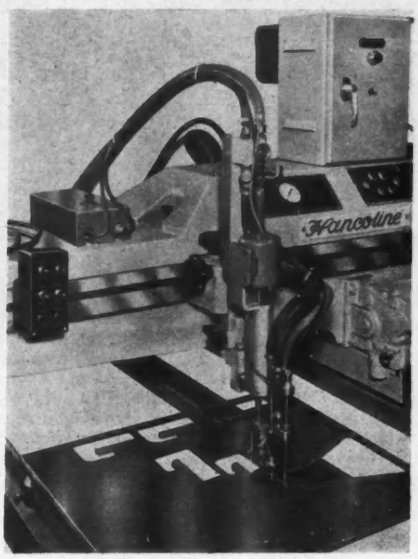
Machine Tools

In this section, which brought in the greatest number of comments and requests from users, only one manufacturer has as yet replied.

To the vague request for a press brake, Mr. N. H. Josephy, sales director, Bronx Engineering Company Limited, answered: "We do not understand this query as there are, of course, many manufacturers of press brakes in Britain and we will be very pleased to put at the disposal of the inquirer our detailed knowledge of mechanical and hydraulic press brakes and also the services of our special press brake tooling department."

One user required shipyard bending rolls which, in addition to bending and flanging facilities, had a device enabling the machine to be used for levelling ships plates. These, too, are available from Bronx Engineering: "As manufacturers of all types of bending rolls, we can offer machines which in addition to rolling, can be used for levelling ships plates. This is achieved by the addition of extra rolls which are run down below the normal pass height of the machine when it is being used for rolling. The combined rolling and leveling machine may have 4, 5, or 7 rolls."

Finally, the company are also able to supply the user who requested "a machine for corrugating steel sheets."



Automatic maintenance of the correct flame height is carried out by the servo-mechanism operating from the sensing ring by the nozzle.

"We supply press brakes and special tooling for corrugating steel sheets," writes Mr. Josephy, "and would be very glad to make available to the inquirer our very great experience of this type of work."

Testing Equipment

In this section a request was made for an instrument for making a quick survey of the wall thickness of cast iron water mains. The user wrote "an ultrasonic thickness tester has proved totally unreliable for this purpose."

Mr. J. E. Wilson, sales manager, Ultrasonoscope Company (London) Limited, wrote to say that his company had recently introduced a miniature flaw detector "which with a suitable probe has proved very successful on similar applications. The thickness of the specimen is read directly from the instrument's 5 in display. From past experience this method has proved more accurate than the results obtained from the use of thickness gauges in the testing of such items as cylinder bores, heat exchange pipes, oil pipe lines, and castings of various types.

Miscellaneous Plant

The requests for cleaning equipment brought forward the suggestion from Kerry's (Ultrasonics) Limited that ultrasonics would provide a suitable answer in many cases. "Equipment is now being manufactured with capacities from 1 litre to 80 gallons (34·515 litres). This vibro-cleaning process overcomes the disadvantages of high temperature, high corrosive cleaning, and expensive hand labour. It is now used in fields as widely differing as the cleaning of surgical instruments, the removal of metallic chips burned on carbon, and the super cleaning of hydraulic components and removal of polishing compounds."

The user inquiring for equipment for drying the insides of 50 ft lengths of flexible corrugated tubing was answered by Wade Engineering. "A small Root's type supercharger driven by electric motor should not cost more than £200 and should be quite suitable for drying lengths of flexible tubing. Assuming a back pressure of 5 lb per sq. in could be generated in the flexible tube, then the temperature rise of the discharged air would be between 70° and 80° F above ambient, and this flow of warm air should effectively dry the tubing."

Cutting Tool Design and Utilization

Present day finely developed cutting tool materials require exacting design to make the most of their properties, and precise utilization to justify them economically.

By J. Cherry, M.I.P.E., A.M.I.Mech.E.

College of Aeronautics, Cranfield

IT HAS been said (ENGNG., 14 April, p. 514) that the new sintered oxides and even harder cutting tool materials, such as silicon carbide (2500 Knoop) and boron carbide (2800 Knoop), present machine tool manufacturers with the challenge of producing faster, vibration-free machines. These materials also present tool designers with the challenge of providing designs which will reduce impact loading significantly.

The two important factors which have a fundamental influence on tool design are (*a*) the effect of primary rake on cutting forces and (*b*) the effect of chip thickness on tool life.

The effect of primary rake on cutting forces is illustrated in Fig. 1, which shows how the vertical and horizontal cutting forces vary with cutting rake when machining 90 ton steel with a high speed steel 5 per cent carbon tool. There is considerable reduction in power consumed as rake is increased, but obviously there is a practical limit to the increase of rake according to the strength of the tool and its capacity for dissipating heat.

This practical limit is shown in Fig. 2, in which tool life is measured relative to cutting rake. The importance of primary rake is shown from the aspects of power consumption and tool life.

A typical graph to demonstrate the effect of chip thickness on tool life is given in Fig. 3, which plots the relationship between cutting speed and tool life, $V T^n = C$, as given by Taylor. Curve A shows this relationship when the chip thickness is 0·005 in and curve B when chip thickness is 0·010 in. It is apparent that for the thinner chip the cutting speed can be increased for the same tool life or, alternatively, the tool life can be increased for the same cutting speed.

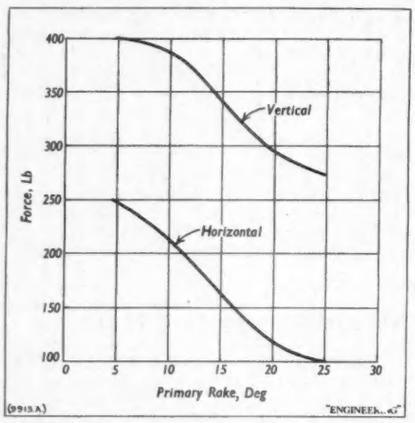


Fig. 1 The effect of primary rake on cutting forces.

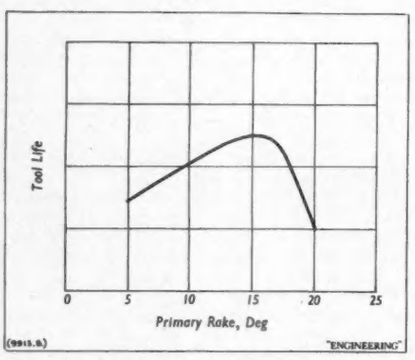


Fig. 2 Tool life in relation to primary rake.

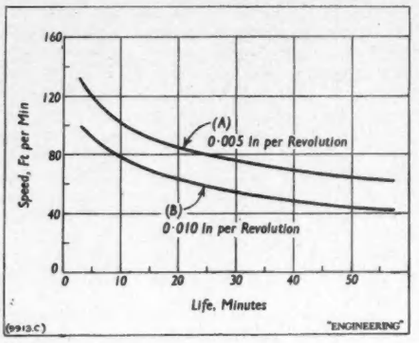


Fig. 3 The relationship between cutting speed and tool life.

This feature is used extensively to improve tool performance as shown in Fig. 4, which illustrates how the chip thickness is reduced by introducing a plan approach angle on a lathe tool while the feed per revolution is unaltered. With these basic considerations in mind, one can consider the design characteristics of individual tools.

Single Point Tool Design

The Cross Chord Tool.—This tool was originally developed to avoid nose breakdown when machining high speed steel. The blade is applied obliquely to the workpiece and passes through its centre line so that a nose on the tool is unnecessary. Because of the obliquity of the blade, the chip thickness is reduced in relation to feed per revolution and, consequently, high speeds are attainable even when machining high tensile steels. This technique has also been applied successfully to boring and roller box turning.

Inserted Tips.—Probably the most significant development recently has been the introduction of throwaway tips. These were originally developed on the grounds of economy, but the elimination of the overhang which is usually present with prismatic tips is a good design feature which has emerged. This is important in reducing vibration and is especially valuable when sintered oxide tips are used.

Drills, etc.

Spiralpoint Drills.—The chisel point of a drill presents a high negative rake to the workpiece,

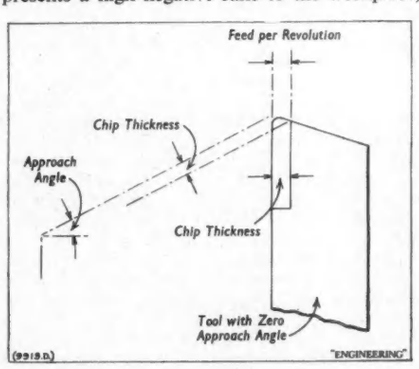


Fig. 4 Plan approach angle on chip thickness.

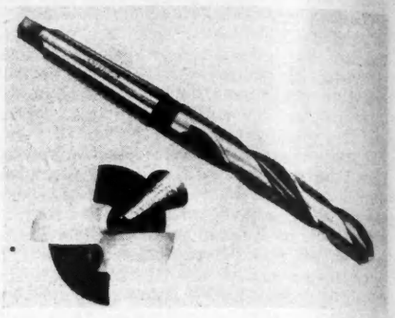


Fig. 5 The chip breaker drill.

inducing heavy cutting loads and poor cutting conditions. The spiral point drill grinding method reduces this negative rake considerably. Thrust loads are reduced and roundness and straightness of hole are improved.

Chip Breaker Drills.—Drilling operations tend to produce long chips which can be dangerous to the operator. The chip breaker drill, illustrated in Fig. 5, helps to avoid this hazard by breaking up the chips. It is also useful in that it permits coolant to flow more freely to the drill point in deep holes.

Oil Feed Drills.—Reduction of friction is very important when drilling difficult materials and, in the normal method of application of a lubricant, the egress of chips tends to prevent it from reaching the cutting edge in deep holes. To counter this tendency, the oil feed type of drill has oil holes through it, supplying the lubricant to the cutting edge.

Reamers

Quick Spiral Taper Pin Reamers.—There are two advantages in using these reamers. First, there is the avoidance of lobing as a result of the better diametral support given by the blades and, secondly, improved production rates are obtained because of the thinner chip produced by the oblique angle blade.

Quick Spiral Parallel Reamers.—These reamers have advantages similar to those of the quick spiral taper pin reamers. However the parallel reamer's left hand spiral makes it more suitable

	Example 1 *Standard tool*	Example 2 *Throwaway tip tool*
Tool change time ..	5 min	1 min
Tool regrind time ..	5 min	Nil
Labour + overheads/min	4*d*	4*d*
Depreciation per regrind	2*s*	Nil
,, ,, edge ..	Nil	2*s*
Speed/life equation ..	$V T^{0·8} = 500$	$V T^{0·8} = 500$
/Feed/rev.	0·010	0·010
Life (T) for min. cost ..	$= \left(\frac{1}{n} - 1\right) R_1$	$\left(\frac{1}{n} - 1\right) R_2$
	$= \left(\frac{1}{0·2} - 1\right) R_1$	$\left(\frac{1}{0·2} - 1\right) R_2$
	$= 4 R_1$	$4 R_2$
	$= 4\left(\frac{20 + 20 + 24}{4}\right)$	$4\left(\frac{4 + 24}{4}\right)$
	= 64 min	28 min
Speed for min. cost ..	$= \frac{C}{T^n}$	$\frac{C}{T^n}$
	$= \frac{500}{64^{0·8}}$	$\frac{500}{28^{0·8}}$
	= 218 fpm	257 fpm
	= 200 rpm	250 rpm
Machining time ..	$= \frac{20}{200} \times 0·010$	$\frac{20}{250} \times 0·010$
	= 10 min	8 min
Machining cost/piece ..	= 40*d*	32*d*
Manipulation cost/piece	= 4*d*	4*d*
Tool cost/piece	= 11*d*	9·3*d*
Total cost/piece ..	= 55*d*	45·3*d*
Production rate.. ..	= 5 per hour	6·4 per hour
Time for 200	= 40 hours (5 days)	32 hours (4 days)

for through holes, where adequate swarf clearance is not provided. The advantages of the quick spiral for reaming blind holes can be obtained by using a right hand spiral.

Milling

End Milling.—The use of a left hand spiral end mill is an advantage since, in addition to reducing the chip thickness and progressively applying the cut, the resultant thrust in the cutter is upwards into the spindle and downwards on the workpiece and table. This is the ideal condition but, unfortunately, owing to the left hand helix, it is not possible to cut on the end with this type of cutter. However, by the addition of separate end cutting blades, as in the "Upwards Thrust" cutter shown in Fig. 6, it is possible to cut on the end as well as the side and still retain an upwards thrust.

Face Milling.—More advance has probably been made in the design of face milling cutters than in any other cutter, and throwaway tips applied to milling cutters have reduced down time.

Similarly, the simplified setting shown in Fig. 7 has reduced grinding cost. A further development is that shock at entry and exit of the cut is diminished by positioning the blade obliquely to the centre, so that entry is at a point only and the width of the chip progressively increases to full width and subsequently diminishes gradually to zero. A further useful feature is the circular blade which can be rotated to present a fresh cutting position.

Economics of Tool Utilization

The correct choice of tool material and design is of paramount importance in machining but having made this choice, it is then necessary to set up the cutting conditions which attain the

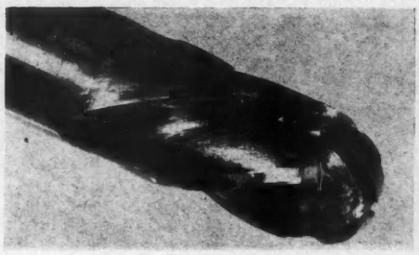


Fig. 6 The "upwards thrust" cutter.

overall minimum cost per piece, taking into account production rate, labour rate, overhead rate and tool cost.

The cutting speed for minimum cost, V_o, is expressed as:—

$$V_o = \frac{C}{T_o^n}$$

where T_o = Life of the tool for minimum cost

$$= \left(\frac{1}{n} - 1\right) R$$

C = the constant in the speed/life relationship $V T^n = C$

n = the exponent in the speed/life relationship $V T^n = C$

R = cost of changing tool + cost of grinding tool + loss of value of tool due to grinding / labour + overheads/min.

As an example in the application of this formula, assume that 200 spindles have to be turned 4 in diameter by 20 in long and a comparison has to be made between the cost when using a standard brazed tungsten carbide tipped tool and that when using a throwaway tip type. The factors are noted in the Table opposite.

It appears that higher production rates are possible at even lower tool costs if the economics of the process are thoroughly exploited. Some

Fig. 7 A simplified setting in face milling cutters.

of the advantage gained was in the use of quicker tool changing, a benefit which should be increased as far as possible by utilising pre-setting devices.

Summary

Developments are continuously being made in tool materials and in tool design, with the object of reducing manufacturing cost by providing a selection of tools to suit individual processes, machines, and materials to be cut. The point has been reached where the majority of existing machine tools are inadequate to fully exploit the sintered oxide tools, and machines with higher spindle speeds and greater power are necessary before maximum effectiveness of present day tools can be attained.

Developments in Valves Will Speed Up Production

An important contribution will undoubtedly be made to speeding up and maintaining production in the processing industries by a new range of valves and valve fittings. Produced by the Newman, Hender Group of Companies of Woodchester, Stroud, Gloucestershire, they are featured in the current Engineering, Marine, Welding and Nuclear Energy Exhibition at Olympia.

Most significant of this new range are valves, claimed to be unique in this country, which can be fully serviced and tested under pressure while still connected to a pipeline. This property will make possible considerable savings in shut-down time in all types of processing industries, particularly those installations—such as refineries and chemical plants—where even the slightest valve leak is both dangerous and uneconomical. Generally in such cases, for convenience and safety, faulty valves are cut out and discarded and replacements welded back into the line.

Apart from the expense of shut-down time, which is often high in processing industries where stopping and starting can be costly and wasteful, this is an expensive operation in terms of replacement and maintenance costs. Using the new Newman-Velan valves, as they are called, it is often possible to reduce these costs considerably. The valves, which are made under licence from Canada, are forged steel bonnetless gate or globe types in sizes up to 2 in.

Newman Hender have also introduced new fittings for some of their established standard valves. These include polytetrafluorethylene (a hard wearing, chemically inert, low friction material) sealing faces; ptfe sleeves on the Newman-Milliken lubricated, parallel plug valves; and O-ring seals on semi-rotary pumps, thus dispensing with the bulky packed gland.

Bigger and Better Electrostatic Paint Spraying

A new electrostatic paint spraying system, the Megastraton, will shortly be available in this country. It is a development of the Statron portable system by by SAMES (GB) Limited and marketed by Aerostyle Limited of Sunbeam Road, London, NW10. The new system is completely automatic and is designed for use in large scale production.

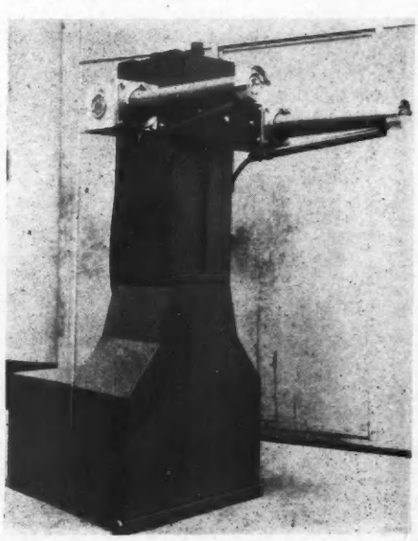
The basis of the equipment is the 150,000 V Felici electrostatic flat voltage/current generator which is small, safe and reliable. In addition to this generator, the Megastraton's equipment includes two atomisers, a set of high and low tension connection cables, and six atomising heads of differing diameters. The unit can be adapted easily to meet particular requirements and can sometimes be fitted in existing equipment.

In operation, paint at low pressure (about 10 lb per sq. in) is delivered to the spray gun together with electrical power at 150,000 V and at 220 V single phase or 380 V three phase. The lower voltage is used to drive a small electric motor incorporated in the gun and the higher voltage, from the electrostatic generator, to charge the paint.

Paint is led to the charged head of the atomiser which is in the form of a cylindrical cup. This cup is rotated by the motor at high speed, the charged paint being thrown out of the end of the cup in an atomised spray by centrifugal force. Because the paint particles thus produced are similarly charged, they are mutually repellent and this helps to disperse the paint.

In this way the equipment produces a cloud of finely dispersed negatively charged paint particles which are attracted to any earthed object in their path. Overspray is virtually eliminated and the volume of solvent vapour is substantially reduced in proportion to the reduced amount of paint mixture required. Generally speaking, reductions in paint consumption from 40 to 80 per cent, depending on the application, can be obtained with electrostatic paint spraying as compared with conventional paint spraying.

No maintenance at all is required on the generator, and on the atomisers it is only necessary to clean the head and the paint tubes after use. The whole equipment consumes less than 200 watts, so is economical on electricity as well as paint.



Megastraton with adjustable side arms.

Mechanical Sealing as it Stands Today

As mechanical seals are required to perform new and more arduous duties, it becomes increasingly important to understand the basic mechanism of the sealing process.

By A. Lymer, B.Sc. (Eng.), A.M.I.Mech.E.
Engineering Manager, Flexibox Limited

UNTIL 20 or 30 years ago the soft packed stuffing box was still universally used as the rotary sealing mechanism to contain the fluid in pumping and agitating machinery. However, as these machines were progressively developed the duty of the seal became more and more severe, thus exposing the limitations of the packed stuffing box, and a need for some alternative—the mechanical seal—was created.

N. Tetlow[1] suggests that the first mechanical seal to achieve any measure of success under difficult conditions was produced in the United States. This was the Cameron seal which in 1928 was used for a number of main line centrifugal pumping sets.

Successful development in this country of a mechanical seal on a particularly arduous duty, probably started with that shown in Fig. 1, where a face type seal incorporating a bellows and oil injection between the rubbing faces was used in 1942 to make a seal on the rotating shaft of a liquid sulphur dioxide pump in the solvent extraction plant of Manchester Oil Refinery Limited. This type subsequently became the Flexibox seal shown in Fig. 2, which is very different indeed from its early predecessor. This, and other seals now mainly encountered are described by F. B. Porges.[2]

In a mechanical seal the sealed fluid is contained between the rotary shaft and the stationary housing by means of two coaxial faces on rings rubbing one against the other. One of the seal rings is urged against the other axially by a combination of spring pressure and fluid pressure. A sliding seal is made between the axially moving seal ring and the shaft (or housing) and a relatively stationary seal is made between the other seal ring and housing (or shaft). To make these seals a bellows, O-ring, chevron or flat gasket may be employed.

Mechanism of Sealing

Ignorance of the fundamentals governing a physical process is not an insurmountable barrier to its successful engineering exploitation. While this lack of insight may be a serious obstacle to the ultimate development and sophistication of the process, a sound technology may suffice in the early stages. Whereas a vast technology has been built up over the years on the requirements for successful mechanical seal applications, knowledge of the actual mechanism of sealing is somewhat confused.

Early theories such as that of A. Brkich[4] were idealized two-dimensional theories. He suggested that the presence of a liquid film between the rubbing faces was essential for effective sealing. He further put forward the view that surface tension of the liquid was the ultimate sealing force. For a particular application the gap or film thickness between the rubbing faces was progressively reduced by the end thrust on them until the surface tension of the liquid film at the gas side exerted a force equal to that from the pressure being sealed. When this stage was reached, leakage stopped. No actual measurements of film thickness were given, however, but it would appear that a few micro-inches only would be permissible. The need for lapping the seal faces to very close tolerances of flatness and smoothness was, necessary.

Seven years later, E. T. Jagger[5] on the basis of experimental work on a face type synthetic rubber seal put forward a similar view.

In the ensuing discussion, however, this was disputed by D. F. Denny on the evidence of work done by the British Hydromechanics Research Association. In one example quoted, a mean film thickness of 23 micro-inches was measured and the measured leakage rate agreed reasonably well with calculated values based on the measured mean film thickness. It appeared, therefore, that ordinary Reynolds equations of flow were applicable to the special case of flow in very thin films subject to intense rates of shear (10^6 seconds^{-1}). Analysing the author's results on this basis it was suggested that the film thickness would be about 60 micro-inches and the calculated leakrate agreed with that measured. Disagreement with the surface tension theory, however, was on the grounds that: (1) once leakage had begun the surface tension could not provide restriction on flow since surface tension exerted no force on a wet surface; (2) surface tension theory required a discontinuity of leakage rate but none such was apparent on analysis; and (3) even so the calculated film thicknesses seemed too great (by about 5 times) for the surface tension theory to hold.

Dr. Jagger, however, could not accept this alternative—that a sealing seal was non-existent. Surface tension theory best explained the known facts. But other theories were put forward. One suggested that elastic deformation of the seal itself had taken place: another that at these high rates of shear the fluid was no longer Newtonian—the effect of a fluid being sheared in one direction caused pressure to be generated acting in a direction normal to the plane on which shear took place. The latter theory was examined by R. I. Tanner[6] and discounted while he suggested that a combination of all three namely surface tension, elastic deformation and non-Newtonian flow might be the answer.

A further factor was introduced by the effect observed by Popper and Reiner[7] who rotated a small disc at high speed in air adjacent to a stationary disc. When the distance between the discs was less than 20 micro-inches an excess of pressure was observed at the centre. Sir Geoffrey Taylor and P. G. Gaffman,[8] unable to accept the non-Newtonian fluid theory as an explanation, suggested that by using the Navier-Stokes equations the excess pressure could be explained by wobble or an axial vibration. The air was considered to be compressible.

There are thus many different factors or rather, combination of factors, which influence the sealing of a mechanical seal.

Seal Engineering

Even now confronted with this situation, one might well wonder how mechanical seals have achieved the success they undoubtedly have. In the beginning the duties allotted to them by way of proving tests, such as sealing almost saturated propane on refinery duties, were those most unsuited to operation with a soft packed stuffing box. Furthermore, the space available to do so had not to be greater than that occupied by soft packing. (This restriction is operative largely even today.) That these were successfully accomplished was largely due to the sound technology on which seal design was based. Subsequently, or course, as their virtues of leak-free sealing, low power consumption, and so on, were more widely realised their use on more modest sealing duties on pumps, agitators and similar plant made very long maintenance-free periods attainable.

Basic Seal Types

The basic essentials of a seal are two optically flat faces—one stationary, one rotary—with one of the two having sliding movement and some form of spring loading to provide the initial face contact. The appropriate packings are also necessary, as is the presence of some suitable liquid to avoid "dry running." This is the simplest form of mechanical seal.

The introduction of "seal balance" enabled much greater pressures to be sealed effectively than would otherwise be possible. The force between the rubbing faces can be controlled by positioning the area of the sealing faces relative to the sliding diameter of the sliding face member. Thus if the latter diameter were to coincide with the inner diameter of the sealing faces, the seal would be a 100 per cent unbalanced and if it were to coincide with the outer diameter it would be a 100 per cent balanced. In actual practice 20 to 30 per cent balance is usual.

It is interesting to note that while unbalanced seals would only be used up to 100 to 150 lb per sq. in a 30 per cent balanced seal would be used up to 1,000 or 1,200 lb per sq. in. The pressure range is increased out of all proportion to the degree of balance, suggesting that some of the factors discussed such as elastic deformation or wobble are also playing their part.

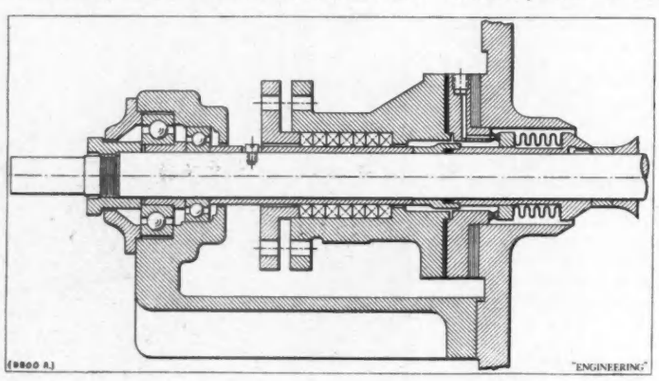
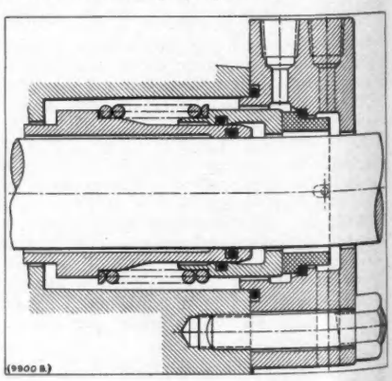


Fig. 1 (left) An early design of face-type mechanical seal.

Fig. 2 (right) A modern "balanced" mechanical seal.



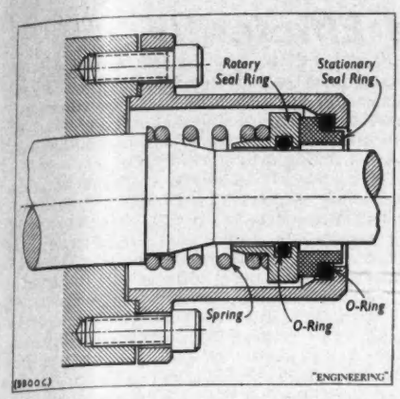


Fig. 3 (left) A simple unbalanced mechanical seal employing only five components.

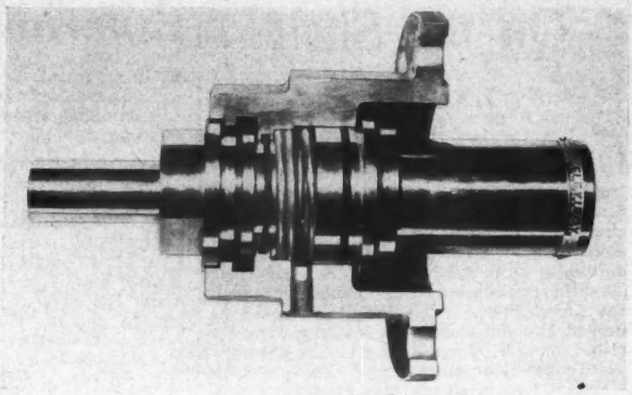


Fig. 4 (right) A double mechanical seal as used on large refrigeration compressors.

Fig. 5 (below) A compact multi-spring seal for high speed applications on aircraft.

Fig. 2 shows a balanced seal and Fig. 3 an unbalanced one. Special features of this particular design are the single spring drive which imparts both the necessary axial thrust while also providing a flexible drive between the shaft and the rotary seal ring, and the stationary seal ring which is resiliently mounted.

By designing for a spring load—whether by single or multi-springs—equivalent to a mean face pressure of 20 lb per sq. in the same seal can be used for both positive pressures and full vacuum. Face materials are chosen for their suitability as mating materials and corrosion resistance to a particular product. Usually stainless steel or a hard-faced stainless steel is used in conjunction with either a " metalised " carbon or a resin-impregnated carbon. A ceramic ring rubbing against glass-filled ptfe is usual for arduous chemical applications.

Packing materials are usually synthetic rubber or asbestos, while ptfe is used for chemical or higher temperature duties (up to 250° C).

For " standard " seals of these types it is found that the operating limit, as set by the face wear characteristics and the heat dissipation of the seal, is represented by the product of pressure (lb per sq. in) and mean rubbing face velocity (ft per minute). The upper limit of this product for an unbalanced seal is about 200,000 and that for a balanced seal is $2{\cdot}25 \times 10^6$.

The above are basic balanced and unbalanced seals with the spring in the product. Usually some additional features are also incorporated as follows.

(1) The softer seal ring may be given a narrow-face to reduce the frictional heat generated without greatly increasing the mean face pressure.
(2) If the sealed fluid has poor lubricating properties injection of a few cc's of oil per day between the seal faces is used. This is the feature incorporated on the first Flexibox seal Fig. 1.
(3) On pumps, the differential head between discharge and suction is used to provide a circulation of the pump fluid around the seal faces. This device is employed to remove frictional heat, or to prevent the settling of abrasives, polymers, or other materials. Where the differential head may be excessive, a flow controller (or restricting valve) is fitted in the circulation line.
(4) A quench tapping is provided at the outermost side of the seal plate for the admission of quenching water or low-pressure steam to flush away any crystal formation or polymerisation near the seal faces. It may also be used as an emergency water cooling system.
(5) When operating conditions are particularly hazardous two rings of soft packing are fitted for use in an emergency on the atmospheric side of the seal.
(6) On refinery duties the packing feature above is replaced by a throttle bush to conform to API and refinery specifications.

With the above basic equipment a great variety of seal problems can be tackled successfully.

Seal Applications

When a sealing problem arises which cannot be solved by these means the designer transforms it into one which can be successfully handled. The following examples illustrate this method.

Food handling requires that region of the seal in contact with food to be free from crevices so that a high standard of equipment hygiene may be maintained. For this and corrosive duties where it may also be desirable to present the minimum of seal in area in contact with the product, the seal is fitted with an externally mounted spring. The unbalanced version is more common. With this design the pressure which can be sealed is limited to about 30 lb per sq. in by the spring force available and by the tendency of the seal rings to be blown out. But this shortcoming can be overcome by fitting an extended spring sleeve or " lift-stop." The balanced version is somewhat rare and requires a stepped shaft or shaft sleeve to allow for the balancing. On both these seal types the seal components are readily accessible and cleaning is made very simple.

An " inside out " version of this type of seal is used to handle highly viscous liquids, paper stock and similar products. Further variations are the all ptfe seal for very chemically corrosive duties and the metal-to-metal (tungsten carbide) faced seal for abrasive duties.

For applications where the fluid being sealed has particularly difficult sealing characteristics it may be replaced at the seal by a very slow injection of some suitable and compatible liquid. Such duties are: abrasive (sandy crude oil replaced by clean oil) corrosive and boiler feed. This last product is particularly difficult —one has to ensure that the water temperature at the seal face is less than that corresponding to its boiling point, otherwise " popping " or " dry-running " may result with a considerable reduction in seal life. One solution is the injection of cold condensate near the seal faces.

Another solution to this and other high-temperature duties is the arranging of a cooled circulation to the seal faces.

For low temperature duties, such as methane at $-100°$ C, a double seal is employed with propanol circulated between the two seals. For lower temperatures a vertical pump is required and the liquid is encouraged to gas by means of an external electric heater. The duty then becomes that of sealing a warm gas, as in the case of blowers and vertical shaft agitators where the seal is in a gas pocket. As some liquid between the seal faces is essential, a double seal is used with a suitable liquid usually at a pressure slightly above that which is being sealed circulated between the seals. Where noxious gases are to be sealed, a double seal is an extra safeguard. A similar arrangement is also used for very low gas pressures (hard vacuum). A double seal arrangement is shown in Fig. 4.

Where the pressure may be excessive, that is to say the PV rating too high, as in the case perhaps of a pipeline pumping set, it may be necessary to reduce the pressure at the seal of the last pump in series by fitting a pressure break-down bleed-off in the form of a neck bush between pump suction and seal.

The maximum speed of a single rotary spring seal is limited to about 5,000 ft per minute to keep down the amount of " bowing " suffered by the centre coils of the spring. For speeds in excess of this, as in marine boiler feed pumps, the spring is stationary. For really high-speed seals (up to 18,000 ft per minute) which have also to be extremely compact for installation into aircraft auxiliaries such as fuel pumps, blowers, and compressors, very special seals like that shown in Fig. 5 are used.

Future Developments

Present efforts are devoted to improving the performance of existing seal types and developing new designs to meet new needs. The introduction of new packing materials, for instance, to withstand even higher temperatures and the steady development work being put into different combinations of face materials should both assist in extending the scope of the standard types of seals.

In addition, there is a demand for larger seals capable of a much higher performance. With the interest in large blowers for nuclear power stations there is a need for a shaft seal able to run faster at a rating beyond the range of the standard seal. Similarly the large electricity generating sets now being built place a high premium on an extremely reliable shaft seal on the boiler feed pumps where the duty is particularly exacting. Very large diameter seals are required for marine stern glands and also for power stations circulating water pumps when they are also required to be split. A trend common to all seal types is that towards cartridge unit seal construction, where the seal unit is fitted into the main equipment with the minimum of fuss.

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On the Shelf

By Frank H. Smith

ONE day I will be rude about publishers who do not send a review copy of a journal until No. 2 of Volume 1. Complete files are a joy to any librarian or subscriber and one missing of any volume is a pain in the neck. Since Volume 1, No. 1, is invariably the most difficult to get of any new journal it is obviously better for publishers to over-produce rather than cut as fine as possible. This natter is aimed not only at *Steamboats and Modern Steam Launches* (No. 2 of which I have just seen) but any prospective new journal producer. The particular magazine I have just mentioned seems to give a new lease to old stuff. It deals with those funny little things that used to chug round the Navy in the form of picket boats and can still, I think, be seen in the Suez Canal with pilots and things aboard. I associate them with brightly polished brass funnel-tops—in fact bright brass all over—and smoke belching out of the stack. This nostalgic effort is American and is published every two months by Howell-North Books, 1050 Parker Street, Berkeley 10, California. $3 a year or 75 cents a copy.

I had a devil of a job finding out what AUB was in *The Review of Engineering at AUB*, but I at last found it to be American University of Beirut. The *Review* is published by the Engineering Students Corporation. I have No. 2 of Volume 1 (!). It contains articles on seepage through porous media, earthquakes and construction therefor, electric power and a dam description. Presumably American University Beirut is enough address.

For some unfathomable reason, Routledge and Kegan Paul say they are "Announcing *The British Journal of Aesthetics*" with Volume 1, No. 2, March, 1961 (!!). "As a Journal of Aesthetics we shall place understanding before edification and we shall have nothing in common with *The Yellow Book* of the nineties or the Vorticists' organ *Blast* . . . Our policy will be to present contributions in as lucid and generally apprehensible language as the nature of the subject permits and to eschew esoteric terminology." Fair enough, I suppose, at £2 per annum or 12*s* 6*d* a copy.

Space-Aeronautics (a Conover-Nast publication) looks a bit ahead in the editorial of the March number with an announcement of a new journal in 1962. It will be called *International Science and Technology*. (205 E42nd Street, New York 17.)

The Union of International Associations (Palais d'Egmont, Brussels 1) offer three books for you (their own phrasing). They point out that in the past 50 years they have produced many books *about* international organizations and now they have produced these three *for* international organizations. So if you happen to be an international organization try (1) *International Congress Organization—Theory and Practice;* (2) *Congress Organizers' Manual* and (3) *Facilitation Problems of International Associations*. Their audience is 1,255 international organizations (awful thought!). The first costs 14*s*, the second 21*s* and the third 22*s* 6*d*.

The Union of International Associations also seem to be concerned about the international meeting position. They are now getting out a *Bibliographical Current List of Papers, Reports and Proceedings of International Meetings* at 14*s* a year. If you wish to pay in sterling, the agent in this country is Mr. E. S. Tew, 91 Lyndhurst Gardens, London, N3.

Map Bulletin No. 14 comes from Edward Stanford Limited (12-14 Long Acre, London, WC2) and the title explains itself. There's a new road map of Bulgaria, if you are thinking of going there this summer, and one of Czechoslovakia. Even further afield, there is a street plan of Alexandria and another of Cairo. (Can I interest you in postcards?)

Experimenting More Efficiently

Statistics Manual. By EDWIN L. CROW, FRANCES A. DAVIS and MARGARET W. MAXFIELD. *Dover Publications, New York: Constable, London.* (12*s* 6*d*)

This paper-back edition of a book, which has for six years been available only in a hard cover edition for $6 through somewhat restricted channels, is probably the best "value for money" of its kind. The present reviewer was fortunate to secure a copy of this book in its original form as a (United States) Naval Ordnance Test Station Manual, and it is with the greatest pleasure that he welcomes it to the ranks of general statistical literature. Readers of ENGINEERING may care to know that at least one well known college of a British university has already adopted the manual for the relevant courses in statistical methods.

Although the manual is in no way intended as a complete exposition of modern statistical methods—a great and formidable task—it does contain a reasonable selection of methods which are of interest and value to scientists and engineers for the purpose of improving the efficiency of experiments. In order to make the manual moderately self-contained the first chapter is devoted to "Definitions and Distributions." There is also a select bibliography to each of the eight chapters, together with a good index for finding one's way about.

The seven chapters following the first consider the following topics: tests and confidence intervals for mean; tests and confidence intervals for standard deviation; tests of distributions as a whole and allied problems; planning of experiments and analysis of variance; fitting a function of one or more variables; quality control charts; and acceptance sampling. These chapters are followed by an appendix of twenty-one tables and nine charts; some of them appear in print (and in book-form) for the first time.

Although it is the product of joint authorship, subsequent review by experts and some editing, the manual is easy to read and, indeed, to understand, since it makes little or no demand upon background technical knowledge. Methods are intended for practical use, not as means of demonstrating theory.

In the foreword and also in the introduction are strong references to the need for consultation with a statistician by the experimental scientist or engineer. The introduction goes further and recommends a more general study of statistical methods if their use is to be at all frequent, and advice is given on the use of the manual.

Attention is drawn to the three aspects of statistical work (1) design of an experiment, (2) reduction of the data (leading to) estimation, and (3) examination of the (statistical) significance of the results. While it is not necessary for engineers, for example, to try and become statisticians there is much to be gained by cooperation leading to a greater understanding of the numerical significance of many problems.

The professional statistician will always find points of presentation with which to differ from authors endeavouring to compile manuals for practical use. For example, in the case of the manual under review there are a number of instances where only a secondary reference is given to support a particular method rather than the original source. This kind of thing is not particularly damaging, however, and this reviewer could find only one point of drafting which might be misleading to the unwary reader. In section 4.4 and 4.5 the term "staircase" is used in two quite different senses. The usage in section 4.5 is the one generally found and in the previous section there is no need for the word to be introduced at all.

But this is no basis for substantial criticism and, indeed, none should be made, for *Statistics Manual* is excellent for its purpose and at a price which should be helpful in promoting a wide circulation.

WILLIAM R. BUCKLAND

Resonant Economic Circuit

Growth in the British Economy. *Political and Economic Planning and Allen and Unwin.* (30*s*)

This important book is the outcome of a three year study by Political and Economic Planning, with the aid of an advisory group, which included representatives of nationalized and private enterprise, the trade unions and economists.

Britain has been investing a smaller proportion of her national income than most other countries. In 1959, private consumption took 65 per cent of our national product, compared with 58 per cent in Germany. Gross domestic fixed capital in Britain, 11 per cent of the Gross National Product in 1938, had risen only to 15 per cent by 1957, whereas in Germany it rose from 14 to 23 per cent.

Although Britain has the lowest rate of capital formation in Europe, capital *per worker* has risen since 1937 by 70 per cent, compared with 25 per cent in the United States and 30 per cent in Germany, which suggests that capital is wastefully allocated between alternative uses. That output per man hour (1953 = 100) had by 1958 risen to 110 in Britain and to 133 in Germany suggests further that the capital allocated is less efficiently used. Britain depends more than any other country on exports and has to compete with countries whose rates of growth are spurred by rapidly rising populations. Britain ought, therefore, to be ahead of all her competitors in scrapping old plants and investing in labour-saving devices.

Such a switch from investment in general to labour-saving investment is one of PEP's main recommendations. "As the expansion proceeds in the 1960's, it will be limited by renewed shortages of labour before all the surplus capacity built up in the years of high investment since 1955 have been utilised." If the United Kingdom continues to invest in ways that merely add to capacity, employers will compete for ever scarcer labour, and soaring wages will lead to inflation. "Several basic industries whose most urgent task in the 1950's was to expand output by any means are now operating in competitive markets where they can only maintain their position by investing in greater efficiency of production," which would release workers for other industries that are suffering from labour shortages.

PEP offers a striking solution to this problem. They point out that in the USA, and in Europe, welfare services add to labour costs because they are financed mainly by a charge *per worker* employed. In Britain, four-fifths of the cost of these services are financed from general taxation. This leads to a low level of taxes on labour and a high level on capital. Taxation on income created by investment is higher than the standard rate of tax on income created by work. Even allowing for initial and investment allowances, there remains a substantial discriminatory tax on capital as against income. Again, municipal rates are charged on the value of the factory or office, rather than per head of workers employed. The European system keeps labour costs relatively high and so gives incentives to raise productivity by using labour economically and substituting capital equipment where possible.

The implications of the measured language in which PEP warns that full employment is an aim which should not take absolute precedence over the balance of payments and keeping British prices in line with world prices should not be overlooked. What PEP is conveying discreetly is

that full employment leads to inflation. The unions do not realise that while they can force increases in *money* wages, they cannot raise the level of *real* wages. Too high real wages cause unemployment.

If wage cuts are rejected, unemployment can only be avoided by reducing the buying power of wages by expanding credit to a level at which money values are in line with real values, which depend on the worker's productivity. This fall in purchasing power provokes new wage demands to "keep pace" with the cost of living.

As this process repeats itself, higher prices cause exports to fall and cheaper imports (from countries with more stable currencies) to rise. A balance of payments crisis threatens. Bank rate is raised. The economy is slowed down, until as rising unemployment (which should lead to a re-allocation of labour, but which is usually counteracted in part by short-time) shows itself, credit is eased and consumption resumes its inflationary way.

Every leader in government, industry, and the unions, is aware of this vicious circle. The way out is to substitute vigorous political, industrial and union leadership for followership. Unfortunately, PEP itself gives no lead here and wanders off into an inconclusive and exhortatory discussion of a "national wages policy."

PEP's chapters on taxation and on the cost of social services are weak points in an otherwise admirable report. Although PEP concedes that high marginal rates at the early surtax levels, and death duties falling on family firms, do harm, they dispute that high taxes discourage enterprise, encourage extravagant expenditure, and promote indifference to inflation. They seem to think because it is impossible to measure discouragement and extravagance in actual figures of production lost, that *therefore* there is no argument against high taxes.

But there is such a thing as non-statistical commonsense. High taxation impedes growth by making it difficult for the small man with new ideas to accumulate fresh capital to try them out; it brings capital more and more under the control of salaried men who have never had the experience — chastening and enlightening — of taking risks to build fortunes of their own. A firm which is making just enough profit to pay its taxes and an average dividend is not adding to national wealth.

Growth springs from the possibility of exceptional profits. Without this big return, why should anyone find the extra capital for costly experiments? Exceptional profits do not "exploit" the consumer, because once a new product or technique has been proved a money-maker, competitors hasten to take it up; they narrow profits by forcing selling prices down and wages and costs up; they compel unprogressive firms to rationalize or be taken over. High taxes promote a static economy by favouring existing big business and preventing the emergence of small and pushing competitors.

PEP also denies (1) that expenditure on the social services is any serious handicap to growth, because it merely represents a transfer of spending from individuals to civil servants, and (2) that consumption is taking a larger share of national resources than it would if individuals were still making their own provisions instead of relying on the social services. This contention provokes the retort that while social service expenditure may (perhaps) not up to now have impeded growth, trouble may still lie ahead, because expenditure on social services is not decided on a cool assessment of what the nation can afford, but (*a*) tends to rise as modern medicine prolongs life and multiplies pensions, and (*b*) is subject to electoral auctions to raise benefits, without thought of the extra burdens saddled on the working population.

Because a relatively few people may suffer through personal misfortune or fecklessness, must we have a gigantic pensions scheme for all so as to avoid a means test for the few? Again, if it is reasonable to charge rents for nationalized housing, is it unreasonable to charge something for the health services or education? PEP's argument implies, on the one hand, that the individual derives as much satisfaction from money spent on him, according to rules, by the state, as he does from saving and spending his own money as he chooses, and, on the other, that civil servants spend the individual's money for him less wastefully, more efficiently, than he can himself.

JOSSLEYN HENNESSY

Multi-Starter Switchboards

A.C. Motor Control and Distribution Gear. By R. T. LYTHALL. *Belmos Company, Bellshill, Lanarkshire.* (15*s*)

There is a shortage of textbooks by British publishing houses on motor control gear and Mr. Lythall's book will be welcomed by engineers seeking information on alternating-current motor control and distribution gear.

After discussing standard methods of starting ac motors, the book outlines some simple control circuits and sequence interlocking schemes, with a useful section on protective gear, including earth leakage and short-circuit protection, and a separate section dealing with the problem of short-circuits related to bus-bars and apparatus of group motor control boards. The section on airbreak flame-proof gear is largely confined to mining practice although much of the industrial flame-proof equipment has been developed from mining experience and it will give the student some guidance regarding the installation of control gear in hazardous situations.

As a source of reference, this book will be invaluable to students seeking information on key diagrams of control circuits and sequence interlocking systems. Many electrical engineering students criticize the lack of electrical drawing office practice in the syllabuses of technical colleges. Although principles of mechanical drawing are covered in the early stages, electrical students seem to be severely handicapped due to the lack of training in electrical circuitry. The excellent series of diagrams given throughout the book should help to overcome this shortcoming.

With an introduction to the development of multi-starter control panels grouped in switchboard form, the author provides a simple lead into this recent innovation, which has been brought about by the need to have a central control point in many new processes where automation is being introduced. Like all new deveopments the multi-starter control panel brings fresh problems which can easily be overlooked by the works engineer when designing a new layout for group motor control. Problems such as the effect of a fault on a panel or motor with many units of different sizes grouped together are dealt with in a concise step-by-step manner.

The section on short-circuits relating to bus-bars and apparatus of group motor control boards, particularly when read in conjunction with the author's previous work *Simplified Short-Circuit Calculations*, give a realistic treatment of the subject. Although faults on modern equipment are infrequent and the protection of individual starters presents no difficulty when grouped and fed from common bus-bars, small starters may be connected to a large power source and their protection must not be overlooked. This protection is particularly important where sequence control is involved.

The book is well written, clearly illustrated and will provide a useful source of reference for students and works engineers who are interested in this new fashion of motor control gear which undoubtedly is here to stay.

F. T. BARTHO

Plot Points as the Test Proceeds

The Testing of Electrical Machines. By LAURENCE H. A. CARR. *Macdonald.* (50*s*)

This book, published posthumously, is one of the fruits of its author's long association with a famous electrical firm. While the number of books devoted to the theory and design of electrical machinery is legion, the subject of testing has hitherto received but scant attention; the appearance of a book on this subject, written by an authority, is therefore to be welcomed.

The opening chapter, dealing with general considerations regarding testing, concludes with a section on terminology in which brief reference is made to "the per-unit system in which quantities other than efficiency are now usually expressed." It is to be regretted that the author did not devote a little more space in this section to a statement of the advantages of the per-unit system as the pernicious practice of specifying quantities, such as reactance in per-centage terms persists in very many otherwise well-informed organisations. Indeed, there is no reason why the use of per-centage values should remain sacrosanct for the declaration of efficiency when the other, more rational, per-unit system exists.

The commercial testing of direct-current machinery is treated very comprehensively in the second chapter. Examples are given of normal and abnormal results illustrated by curves, and the reasons for the abnormalities are discussed. In this chapter, as in all those that follow on testing procedures, the author uses as an example a machine which was built and tested during his active career. The full test results are given together with calculations made from them to establish performance, and comments are made on the results where appropriate.

Wherever possible throughout the book, test results are shown plotted in graphical form. The curves are not "idealized" in any way; the actual readings are plotted as distinct crosses exhibiting the normal amount of scatter which testers and designers always expect to find and the usual smooth curve is drawn through them. The appearance of any point "off the curve" leads to an immediate investigation. This is a practice which cannot be too highly commended; if all test results were plotted even quite roughly as the test proceeded, the waste of many hours of testing time could be avoided as well as a great deal of doubt and irritation subsequently experienced by members of testing and design staffs alike.

In the treatment of the induction machine, too much space is devoted to the construction of the Heyland diagram. The author attempts to justify its inclusion on the grounds that all the quantities needed for its construction are readily obtainable directly from test results. While this is undoubtedly true, the circle diagram is never used today for the presentation or analysis of test results and no space should have been allotted to it in the volume. The normal test curves of the sample machine, however, in this case a 5,000 hp induction motor, are very true to life and well presented.

Three chapters, logically placed in the book, are devoted to purely theoretical matters and in

two of them, " The Sudden Short-Circuit of an AC generator " and " Further Synchronous Theory," the author has not hesitated to resort to the mathematical treatment essential for the proper understanding of the subject matter but his treatment is clear and well illustrated with curves. The chapters that follow deal in comprehensive fashion with the electrical testing, presentation and analysis of test results of synchronous induction and synchronous motors, salient-pole generators, synchronous condensers and turbogenerators. The treatment of all these classes is thorough and satisfying.

Too little space is accorded to the mechanical testing of electrical machinery. This is all the more disappointing as mechanical tests are becoming an increasingly prominent feature with the present trend towards very large machines cooled with high-pressure hydrogen and, in the most advanced cases, with direct liquid-cooling of the windings. A chapter could well have been devoted to pressure tests, gas leakage from casing and hydrogen seals, gas entrainment in sealing oil, leakage between gas and water circuits and the like, which occupy an increasingly large proportion of the total testing time of the modern electrical machine.

Two idiosyncrasies of the author may cause his reader some irritation. In all the Argand diagrams in the book, and they are many, the positive real axis is taken vertically upwards instead of in the conventional " horizontal to the right " direction, resulting in the diagrams only becoming recognisable if the page is turned through 90°. Also, the author's refusal to adopt accepted symbols for two-axis quantities leads him to use X_{STD}, for example, for sub-transient direct axis reactance in place of the generally accepted and much more compact X''. These, however, are minor criticisms of a welcome book which can be read with interest and advantage not only by those whose duty it is to carry out tests but also by those who specify the tests to be taken and who have the subsequent pleasure of analysing the results.

It is a matter for the greatest regret that we cannot look forward to further revised and enlarged editions of this work from the pen of the same author.

H. V. TUCKER

Multiple Beam Interferometry

Surface Microtopography. By S. TOLANSKY. *Longmans.* (55*s*)

In his latest book on multiple-beam interferometry, Professor Tolansky summarizes the work carried out in his laboratory during the past 15 years, giving an up-to-date account of the practice and applications of the interferometric techniques which he has developed and stimulated.

The aim of the book is to show what can be achieved when the techniques are applied to the study of the microstructure of surfaces and the author succeeds admirably. There are no less than 359 plates and the salient features of each interferogram are pointed out, although in some cases the explanation of how the author arrives at such interpretation is, of necessity with such a very large number of photographs, somewhat brief.

It is not, however, intended as an introductory book on the subject, although the first five chapters sufficiently summarize the theory and the underlying techniques to permit an appreciation of the chapters that follow.

Multiple-beam interferometry is not a technique which can be universally applied and the author quite clearly points out the limitations of the method as these arise. Interferometry is essentially a laboratory art but as Professor Tolansky points out in his preface the full power and elegance of a correct multiple-beam topographical technique has sometimes not been appreciated. High vertical resolutions are claimed for the method, a figure of 10 Ångstroms being quoted for extreme cases.

Basically the technique is simple. A beam of collimated monochromatic light is partially reflected by the under-surface of an optically flat test plate and partly by the surface under test. Differences in the separation of the surfaces lead to the formation of an interference pattern which is essentially a contour map of the surface under examination. The fringes obtained in this way are, however, equal in width with poorly defined edges. With multiple-beam interferometry the surfaces are made highly reflecting and the light is thus reflected a great many times between them. This approach results in a considerable sharpening of the fringe system leading to a much higher order of sensitivity and accuracy. To obtain high-definition pictures, however, careful attention to detail is essential. It is this detail which the reader will find throughout this book.

The work is conveniently divided up into eight parts, six of which deal entirely with applications of the technique. The subjects illustrated include the topographies of crystal faces with chapters on crystal growths; crystal cleavages, including some most interesting work on matched cleavages; crystal oscillators; impact and abrasion resistance and studies of surface deformations, which, apart from dealing with indentation hardness testing, also contain Professor Tolansky's work on percussion ring-cracks in diamond. The last part is by way of being an appendix which includes a chapter entitled " Fringes of Equal Tangential Inclination."

Accounts of experiments on the contouring of surfaces by evaporated films are also included in the text. The silvering of the surface to be examined is an essential part of the multiple-beam technique and it is demonstrated that this contouring is perfect even for films up to 6,000 Ångstroms (approximately 24 micro-inches thick.

Among the many other subjects covered are slip phenomena, the machining of metals, spark erosion, directional abrasion resistance on diamond, polishing and sawing of diamond and the wear of a glazier's diamond. Much of the work discussed has not been published elsewhere.

A useful feature of the layout of the book is that subject headings are given at the beginning of each chapter and references to work other than that carried out at London University are given in the text as they arise. The book is well written, although one might find the author's habit in the earlier chapters of writing " it will be shown later " without reference to page or chapter somewhat frustrating.

Professor Tolansky's book will be of interest to a wide variety of research workers and an asset to those already using the techniques. It is perhaps best summed up in the author's own words: " The function of the report is to emphasise where and how the techniques have already yielded useful knowledge, in the hope that other workers will be induced to adopt them."

R. C. SPRAGG

New Books

The Birth of the Bomb. By RONALD W. CLARK. *Phoenix House.* (16*s*)

This is the story of the development of the atom bomb, from Hahn's first experiment in 1938 to Nagasaki.

Watch and Clock Yearbook, 1961. *N.A.G. Press, 226 Latymer Court, London, W6.* (3*s* 6*d*)

General and historical articles on a variety of subjects within the field of horology are accompanied by a buyers' guide and a list of trade names.

Machinery's Handbook. 16th Edition. Edited by HOLBROOK L. HORTON. *Industrial Press, New York; Machinery Publishing Company, Brighton.* (88*s*)

A standard reference book for the mechanical engineer, draughtsman, toolmaker and machinst, published regularly since 1914. Its 2,000-odd pages are profusely illustrated with diagrams and tables, and it is well indexed.

The Continuous Casting of Steel in Commercial Use. By K. P. KOROTKOV, H. P. MAYOROV, A. A. SKVORTSOV and A. D. AKIMENKO. *Pergamon Press.* (50*s*)

In 1955 a production-size continuous casting plant was started up at the Kradnoye Sormovo Works in Russia. This is one of the few, and one of the largest, such plants in the world, and the design, starting up and operation are described in this translation from the Russian.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Activities

Chain Drives. RENOLD CHAINS LTD., Wythenshawe, Manchester. Examples of Renold chain drives throughout the world. Folder 10 pp ill.

Specialist Services. MORFAX LTD., Willow Lane, Mitcham, Surrey. Specialist machine shop for prototype development and production. Examples of machines available and of items made. 30 pp well ill.

Durgapur. DAVY & UNITED ENGINEERING CO. LTD., Darnall Works, Sheffield 9, and WELLMAN SMITH OWEN ENGINEERING CORP. LTD., Parnell House, Wilton Road, London, SW1. Detailed description of the rolling plant at Durgapur with layout drawing (18 pp ill) and description of furnaces, casting and pits also with layout (16 pp ill).

Fifty Blast Furnaces. ASHMORE, BENSON, PEASE AND CO. LTD., PO Box 17, Stockton-on-Tees. Pictorial details, some in colour, are given of 50 furnaces completed since 1928. 60 pp ill.

Roads, Dams and Bridges. TARMAC LTD., Ettingshall, Wolverhampton. The activities of the Tarmac group include the construction of roads, dams, bridges, railways and sewage works. 62 pp well ill.

Civil Engineering. SIMON-CARVES LTD., Cheadle Heath, Stockport. Steel and concrete constructon from site to roof. Many examples. 24 pp ill.

The Reviewers

Dr. W. R. Buckland, on the staff of the Economist Intelligence Unit Limited, is manager of its Statistical Advisory Service. He holds degrees in statistics and applied statistics, is a fellow of the Royal Statistical Society and the Association of Incorporated Statisticians, and is a member of the American Statistical Association, the Institute of Mathematical Statistics, the Biometric Society, the Econometric Society and the Operational Research Society. He is also joint author with Professor M. G. Kendall of *A Dictionary of Statistical Terms.*

Mr. Jossleyn Hennessy, M.A., is an economist, broadcast commentator and London editor of the *Eastern Economist*, New Delhi. He is the author of several books, including *The European Common Market: What Will it Mean to You.*

Mr. F. T. Bartho, Assoc.I.E.E., M.Inst.W., F.A.M.E.M.E., is with the Industrial Motor Division, Crompton Parkinson Limited. He is also joint author of *Factory Electrification* (Macdonald).

Mr. H. V. Tucker, is a member of turbo-generator engineering department, Turbine-Generator Division, Associated Electrical Industries (Manchester) Limited.

Mr. R. C. Spragg, B.Sc., A.Inst.P., has been attached to Taylor, Taylor and Hobson's research department for the past seven years and has been engaged on precision measurements of small displacements and design of surface finish instruments.

Marketing

Gay Persuasion Wins Coal Converts

HAVING flexed its muscles in the competitive world of fuel marketing the NATIONAL COAL BOARD has launched a spring campaign that after its vigour is chiefly remarkable for its breadth of communication.

Whether the coal consumer is an industrialist, a housewife, a school manager or a member of his parochial church council he or she is unlikely to miss seeing a relevant advertisement or news release from the Board.

The NCB campaign to industry uses the coal burning experience of 80 successful companies, ranging from THOMAS HEDLEY (Tide and Daz) and FORD to the DISTILLERS COMPANY and MASSEY FERGUSON. More generally, what the Board calls its semi-industrial campaign draws on schools and other services, including dairies and laundries.

Each region is making use of specialized advertising. Particularising by occupation as well as by area, there is an intensive programme of technical advertising to the engineering profession, to architects and to other special groups.

Taking up the important media outside the press the NCB has an ambitious effort in colour demonstration films, in display advertisements for retailers that will make quite a stir in the High Street, with stands at more than 40 exhibitions and with 50 showhouses all, of course, heated by solid fuel.

Perhaps the most important single promotional step of all, the Board's summer prices scheme, is being actively brought to the attention of the public. There are solid advantages to the Board, to the distribution system with its winter breakdowns, and to the customer if the summer sale of coal can be substantially raised.

Behind the scenes the divisions have been improving the services of their technical customer advice organisations and supporting the efforts of their allies, the coal merchants and the appliance distributors. There should be little risk of the coal convert, persuaded by all the babies and successful young people of the advertisements, slipping off the hook through lack of accurate advice on particular requirements.

Diverse Products from Toshiba of Japan

A radar spotter capable of detecting typhoons 300 miles off has been developed by the Japanese TOKYO SHIBAURA ELECTRIC Company—TOSHIBA. The typhoon spotter is the largest meteorological radar unit in the world.

Toshiba, which has an international reputation for light bulbs, transistors, television sets, and telephonic and tape equipment, is moving into the field of heavy electric and electronic products for the export markets. The company's generators, transformers and turbines are in service on three of the five continents.

One large parabolic antenna system in Northern Japan is able to pick up microwave signals from Tokyo, 194 miles away, without using relay stations. Still among the large scale operations, Toshiba have produced a 15 million electron volt betatron, the largest yet made, for cancer treatment.

BBC Order Five New Mobile Control Rooms

The BRITISH BROADCASTING CORPORATION have ordered five mobile control rooms, to specifications incorporating the latest production and engineering experience of the Corporation, from PYE Limited, of Cambridge.

Four of the control rooms, each of which has four camera channels, are to be used by the Welsh, Scottish, Midland and West of England regions, where they will replace the former three camera channel units. The fifth control room will augment the outside broadcast facilities in the London area.

With a body width of 8 ft, the new control rooms are built on a 7 ton commercial vehicle chassis. Working conditions are safeguarded by making the production area, which is air conditioned, separate from the equipment compartment. Wherever possible, transistorization has been used to cut down on power consumption and heat dissipation.

A new departure is that of making the vision mixer control panel a detachable unit capable of being operated at distances of up to 300 ft from the main equipment. Complex outside broadcasts may be handled by two mobile control rooms working together with the production coordinated in one of them.

Each of the five units will have four Pye 4½ in image-orthicon camera channels. The new mobile control rooms will be able to operate on the European 625 line standard of definition or the United States 525 line, as well as on the current United Kingdom standard of 405 lines. This triple standard will give greater ease of working when making video-tape recordings for use overseas or when taking part in Eurovision arrangements.

The first of the new control rooms is expected to be delivered to the BBC in the latter half of 1962.

Gear Hobbing Sales Agreement

BPS MACHINERY AND SPARES, of Knightsbridge, London, have been appointed sole agents in Great Britain for the STAEHELY range of gear hobbing machines. The Staehely range includes machines with a capacity of up to 33½ in and 2 DP. The BPS Machinery company are also the manufacturers of fully automatic magazine loaded machines.

Marconi Instruments Touring North Europe

Adding another 3,000 miles to the 12,000 it has travelled in the past 18 months, the MARCONI INSTRUMENTS' mobile demonstration unit is currently on the first lap of a sales tour through Germany and Scandinavia.

Cologne, Hanover, Brunswick and Hamburg are on the list of German centres to be visited. After Northern Germany the tour runs through Denmark, Sweden, Finland and Norway.

More than 30 instruments, capable of being demonstrated in the show room or on the factory bench, are carried in the main display section. Among the exhibits are oscilloscopes, signal generators, valve voltmeters, power meters, bridges and frequency measuring apparatus.

Leyland—Yugoslavia Manufacturing Agreement

INDUSTRIJA MOTORA RAKOVICA, the Yugoslav manufacturing concern, have production rights for the next ten years to make Leyland's Worldmaster underfloor engined passenger chassis, under an agreement recently concluded between the company and LEYLAND MOTORS Limited.

Coupled with the agreement is a contract for Leyland single deck buses and spares worth more than £1 million. Poland still holds first place as Leyland's best customer in Eastern Europe but this is the first time that Leyland has entered into a manufacturing agreement in that area.

IMR, who once produced aircraft engines and now make petrol engines, will now have the right to manufacture Leyland's large 0·68 diesel engine, producing 150 hp. In its horizontal form this is used in the Worldmaster. The 160 Worldmaster buses ordered by the Yugoslav company are to be used on services in Belgrade by the city's municipal transport company—GRADSKO SAOBRACAJNO PREDUZECE.

The bus bodies will be built to the special interior height of 2·1 metres to accommodate the tall Yugoslav people. The bodywork is being subcontracted to METROPOLITAN-CAMMELL-WEYMANN Limited. These bodies will make more provision for standing than sitting. They will have only 23 seats, but the capacity to carry a total of 100 passengers.

Leyland's history in Yugoslavia goes a long way back. Their diesel trucks were the first post-war goods vehicles taken into service in the country. A fleet of Leyland trucks built for war service and supplied to Yugoslavia by UNRRA soon after the end of the war did valuable work and made the makers' name widely known.

Leipzig Crane Exhibit Sold to East Germany

The Rapier 1520 mobile crane shown at the Leipzig Trade Fair by RANSOMES AND RAPIER, of Ipswich, has been sold to the East German Government. It is to be used on public building projects.

The Rapier 1520 is a new model, loading up to 15 tons and able to be fitted with cantilever jibs up to 50 ft long or strut jibs up to 80 ft. The machine attracted a great deal of interest at the Fair, not only from the East Germans, but also from purchasing executives from the USSR, Czechoslovakia, Poland, Hungary and China.

Australia Reduces Imports Bill

An indication that Australia's internal credit squeeze is beginning to take effect on demand is given by the fall in the value of imports last month. At £A89,300,000 (£71,440,000) Australia's imports were the lowest they have been for the past six months, although still well above the level at which imports were running before the removal of import licensing in February, 1960.

Over the first nine months of the current financial year Australia had an adverse trading balance in merchandise of £A184,300,000 (£147,440,000) against a favourable balance in the same period of the previous financial year of £A35,500,000 (£28,400,000).

de Havilland Produce the Directors' Jet

Announcement of the HAWKER SIDDELEY group's decision to go ahead with the production of the first jet engined British built executive aircraft coincides with the statement from the UNITED STEEL COMPANIES, of Sheffield, that they have bought 108 acres of land ten miles south of the city for development as an airfield to be used by the companies' aircraft.

So far as the United Steel plan is concerned, town planning approval has been given and work is going on with the preparation of an 800 yard runway. What are the prospects for the DE HAVILLAND AIRCRAFT Company's aircraft?

The decision follows years of market research and close watch on the growing use of private aircraft by industrial and commercial companies. Such a project is reasonably enough described as long term and an investment of several million pounds is being made in an aircraft which it is hoped may remain in vogue for 20 years. First deliveries are expected in 1963 and a batch of 30 is being laid down.

To be known as the DH 125, the executive jet will be driven by two Bristol Siddeley Viper turbojets. It will carry a crew of two and six passengers in seating described as luxurious, or eight passengers under airline conditions, plus luggage. Stages can be up to 1,500 miles, with normal fuel reserves, when cruising at between 450 and 500 mph.

Since the DH 125 cabin can be fully pressurized and air conditioned the aircraft will be able to fly above disturbed weather conditions. This may prove to be one of the decisive factors in making a success of business flying in the mixed climatic conditions to be found over the United Kingdom and to some degree over Western Europe. The DH 125 will also have the necessary advantage of being able to operate from small airfields.

Anglo-Swiss Cooperation on Indian Contract

Representatives of HUMPHREYS AND GLASGOW Limited and CIBA Limited, of Basle, have been in Bulsar, India, agreeing the final details of the expansion programme of ATUL PRODUCTS Limited for napthalene intermediates and fast colour bases in the dyestuffs field.

CIBA are to make available to Humphreys and Glasgow, and to Atul, their manufacturing process and technical information and will also act as advisers. Humphreys and Glasgow will be responsible for engineering, planning and building the plant. Atul personnel are to be trained in the CIBA works at Basle.

The completed project will cost between £2,500,000 and £3,000,000.

Lincoln Motor Generator

Apart from revolutionising engineering design, the use of welding as an everyday process has led to the birth of some notable items of welding equipment.

IF THE Lincoln portable motor generator appeared on What's My Line, its answer to the question "Do you perform a service?" would be "Yes". And if an engineer were then to ask the question "Could you do this service for me?" the answer would again be "Yes", for its prime purpose in life is to act as a source of dc output for arc welding.

Why is the Lincoln machine to be found on nearly every steelwork construction site or plate shop floor? Basically, because it combines reliability and robustness with provision of electric current of the correct characteristics. Mild steel, stainless steels, alloy steels, cast iron and non-ferrous metals from 22 swg thickness upwards can all be welded using it as the power source.

The Lincoln Electric Company Limited of Welwyn Garden City, Herts, are specialists in the field of arc welding equipment. As well as welding machines they manufacture the consumables associated with welding operations, such as the electrodes, flux for automatic welding, electrode holders and welders' accessories. Perhaps out of all their products their "bullet" or "Shield-Arc" motor generators, to use the trade name, have achieved the greatest prominence.

The motor generators fall into four broad classes, the small, medium and large sized constant current (drooping characteristic) machines, and the constant potential type. Choice of machine for this Product Profile has fallen on the medium sized constant current type, of which the 300 amp may be taken as the basic machine, and which has been in production since before the war. The constant current type of machine is still being produced in increasing numbers, a striking proof of its success.

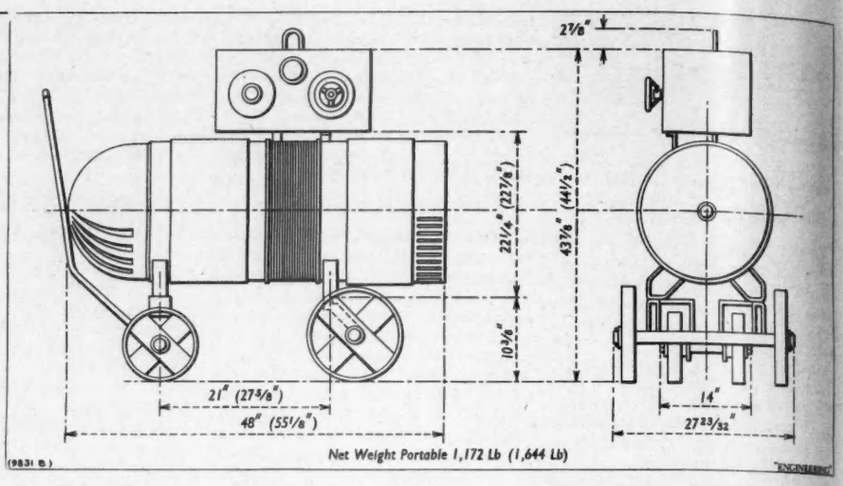


Fig. 1 Outline drawing of 300 amp generator (figures in brackets refer to the 600 amp machine).

All Lincoln motor generators are portable, and the characteristic bullet shape applies to the horizontal machines; that is, all except the two smallest sizes, the 150 and 200 amp constant current machines, which are arranged vertically. The horizontal arrangement starts with the 300 amp size and 400, 600 and 900 amp capacity machines are also made. The main difference in the four sizes is the length which varies according to the capacity of the windings, the diameter quoted in Fig. 1 remaining constant in the three smaller models.

COMPANY ORIGIN

The Lincoln Electric Company Limited owed its existence in the first instance to the Lincoln Electric Company of Cleveland, Ohio. This company was in the forefront of development of the arc welding process in the world, and between the wars representatives were established in this country to market Lincoln products over here.

In 1935 a factory was set up at Welwyn Garden City. Production started with electrodes only but soon extended to dc welding machines and equipment. The 300 amp motor generator was one of the first items of equipment to be started there in 1936, the British interest being established as a subsidiary company in the same year. It was soon followed by the 400 and 600 amp machines. The start of hostilities in 1939 gave welding a tremendous impetus and rapid expansion took place. Among the many new products started then was the 900 amp machine.

By 1950 the firm was a fully-fledged British company in its own right, the last link with Cleveland having been severed. In addition to the original factory the company also occupied two adjacent premises, and it was soon evident that the limit of expansion with the existing facilities had been reached. Early in 1955 the GKN group became interested and provided Lincoln with the necessary financial backing to build a completely new and much larger factory and offices on the outskirts of Welwyn Garden City occupying an 11½ acre site. The company were thus able to celebrate their 21st anniversary in 1957 by moving into their new quarters. Incidentally this milestone was marked too by the introduction of a new motor generator, in this case the first of the constant potential machines.

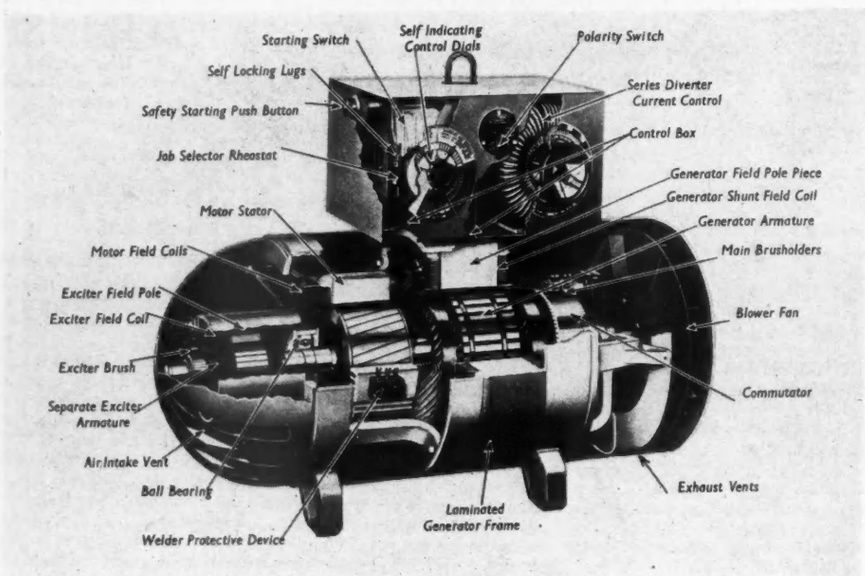


Fig. 2 Cutaway of constant current machine.

CHARACTERISTICS

Lincoln constant current generators are differentially compounded and separately excited. To be a success, a portable motor generator must have:

(1) The right characteristics for arc welding.
(2) Sufficient sturdiness to withstand rough usage on field operations.
(3) Ease of maintenance.

In common with other items of plant used on construction sites where ability to withstand rough handling and the severest operating conditions is the prime consideration, styling plays only a small part in the success of the Lincoln generator. The allied features of simplicity, ruggedness and reliability are those that really count; and even in the latest machines there is no significant difference in styling and general design from the early examples. As befits a firm selling a welding service, welding has been used extensively in the general construction of the machines—and, incidentally, in the structure of the factory where they are made.

The generator has been designed for easy maintenance, so that there is the least possible that can go wrong and the maximum accessibility when something does. Perhaps the most signi-

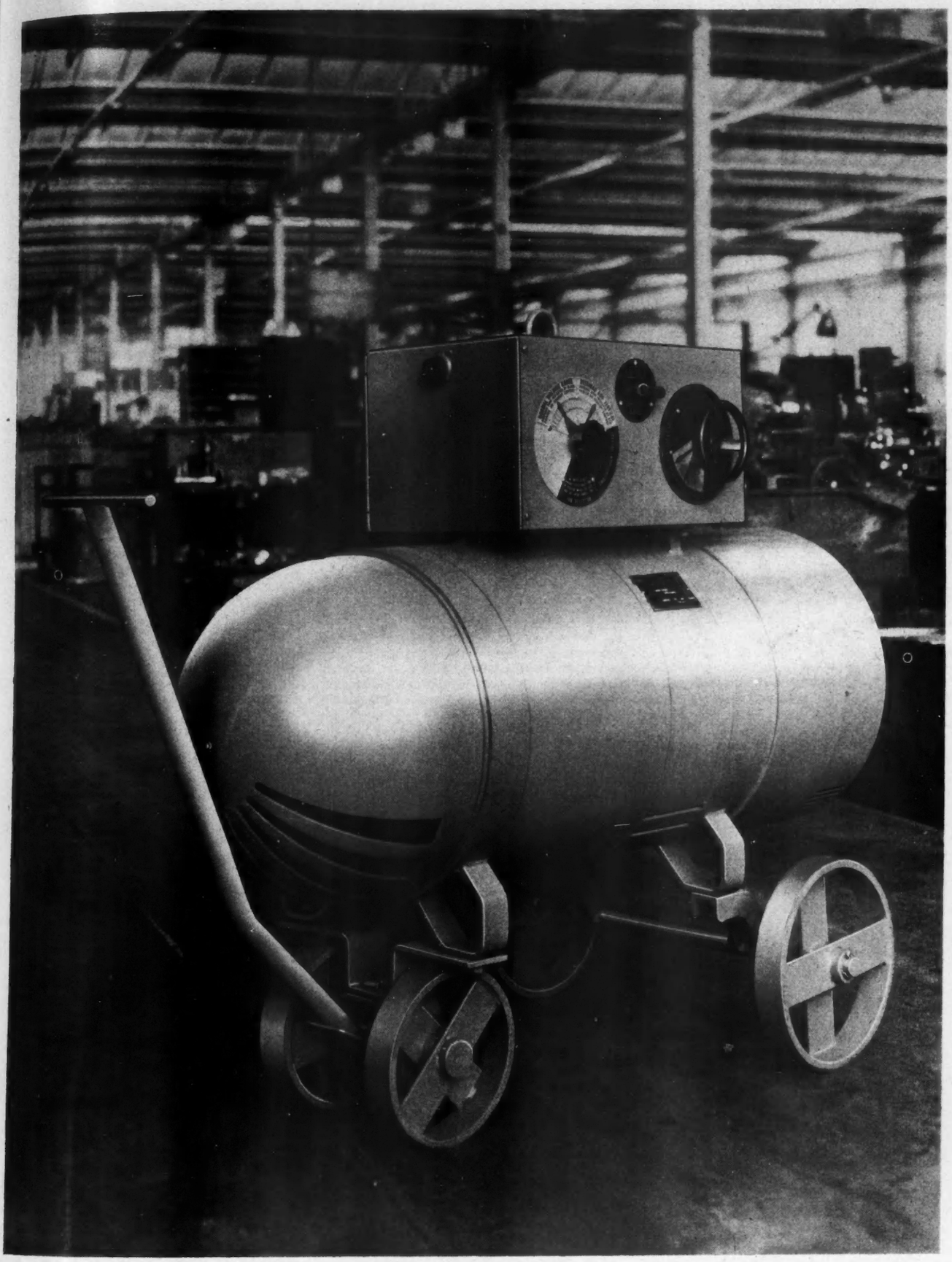


Fig. 3 The essence of success—providing the customer with service.

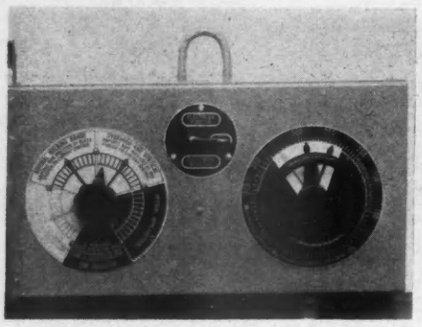
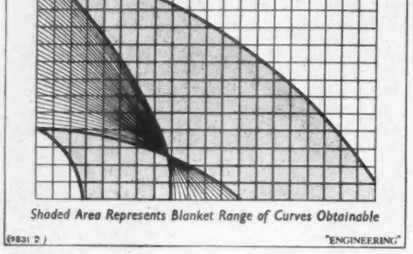


Fig. 4 (above) Control box.

Fig. 5 (below) Typical drooping output curves showing the effect of adjustment of the volt/ampere setting.



ficant feature of the mechanical design is the combined ac/dc armature, which can be withdrawn as one unit. For descriptive purposes the machine may be considered under the following six headings:—

Generator.—The dc generator is NEMA rated and of the single operator variable voltage type, having a fully laminated frame and pole pieces and equipped with interpoles. Typical drooping characteristics are shown in Fig. 5, and dual continuous control of both the series and shunt fields is provided. The generator supplies a uniform welding current for metallic arc welding with either bare or heavily coated (shielded-arc) electrodes, and also for carbon arc welding.

Generator Control.—A shunt field rheostat enables the open circuit voltage to be adjusted in a continuous sequence. A series field diverter permits adjustment of the current independently of the open circuit voltage, also in a continuous sequence. The series diverter is one of the strongest features of the Lincoln machine and was introduced shortly after the company started production.

The combination of the two controls enables the operator to select both the type of arc and the arc intensity to suit his particular job. All the control parts are contained in a steel control box mounted on top of the machine, and large diameter dials and controls permit the operator to determine directly the current obtained with any particular control setting. The control box is divided internally into three compartments for keeping separate the ac circuits, dc controls and dc output terminals.

Motor.—The motor is of the self-protecting squirrel cage induction type arranged for direct on line starting; alternatively a star-delta starter can be fitted to customer choice. The motor is sized to withstand heavy overloads, and can be supplied to suit various supply characteristics.

Motor Control.—A protective control device is fitted in combination with the magnetic starter to provide overload, under-voltage and no-voltage

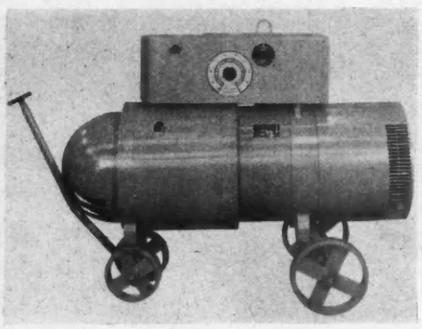


Fig. 6 (above) A constant potential machine.

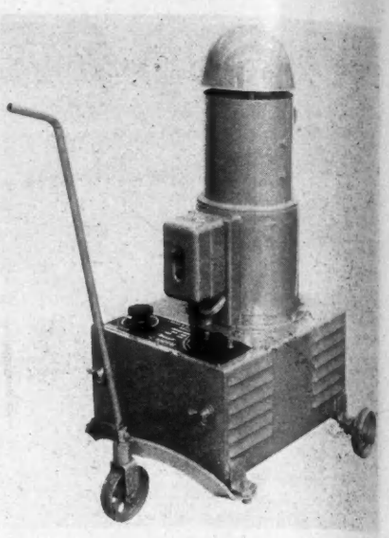


Fig. 7 (right) One of the smaller models, 150 amp.

protection. This device consists of two current transformers and two snap action thermostats, which are connected to the laminations in such a way that they operate by means of heat conduction as well as by current passing through the thermostat.

Exciter.—The exciter and main generator are electrically separate. The exciter is amply sized and mounted within the rounded nose at the front of the machine, the motor end. Its armature is sleeve mounted on an extension of the common motor and generator shaft for easy withdrawal.

Protection.—The thermostats are so arranged that apart from the conditions already described, protection against the following contingencies is provided:—when the motor generator is being operated in excessive heat and it exceeds the safe operating temperature; if the motor is cold and excessive currents which would eventually damage the motor occur for a short period of time; if the starting switch is closed when the motor is connected to single phase lines causing excessive heating of the thermostats; if a fuse blows causing the motor to run on single phase; if the motor becomes locked under full power; or if the motor generator is subjected to sustained over-loading.

A polarity reversing switch is fitted, together with a dial sufficiently large to be read at some distance from the machine. A safety push button is provided which can be locked in the "off" position so that it cannot be set "on" by an accidental bump.

SALES SERVICE

In conjunction with their generators, Lincoln offer an optional set of hand welding accessories. The set includes 30 ft of electrode and ground cables, electrode holder, face shield, wire scratch brush and chipping hammer. To emphasize Lincoln's policy of providing a full welding service rather than just items of equipment, a large staff of qualified field engineers are always ready to call on an existing or a prospective customer and discuss his particular welding problems. A 24-hour emergency service is provided for a customer who suffers a breakdown of his equipment with the consequent threat to production. Much of the company's business stems from the good name they have established over the years, to which the functional efficiency and reliability of the motor generators have no doubt contributed. Prospective customers are encouraged when practicable to send samples of their work to Welwyn Garden City, so that Lincoln can determine the best welding procedure.

A comprehensive repair and rehabilitation service is provided for used machines, many of which require attention due to neglect or abuse over long periods of time. Machines are still being returned for overhaul that have been in constant use for twenty years and more.

No description of the Lincoln generator would be complete without mention of the latest generator development, the constant potential machines. Two sizes are made, 400 amp and 750 amp; they were completely designed at Welwyn Garden City and bear a strong family likeness to the constant current type. They were designed to suit "automatic welding" processes, a term generally accepted in industry to mean welding using a continuous wire feed in place of a hand-held flux-coated "stick" electrode in a holder. Continuous wire feed can also be provided on hand-held equipment, but its advantages are more apparent on a fully automatic system wherein the electrode holder is mounted on a travelling carriage, arranged to travel along the line of weld.

The constant potential generator is intended specifically for such applications using either the submerged arc process, wherein a granular flux is poured continuously over the arc to prevent interaction with the atmosphere; or the CO_2 gas shielded arc, a new process now being actively developed by Lincoln. For CO_2 welding it is the most suitable type of machine.

No current control is necessary on the constant potential generator since the current is inherently related to and dependent upon the wire feed rate. The series field windings are cumulatively compounded and the field control consists of tappings so that a flat characteristic is obtained throughout the whole range. The 750 amp machine was introduced about four years ago, following some preliminary development work in step with the BWRA on CO_2 welding.

One of the advantages over the constant current machine for automatic welding is that the constant potential type is continuously rated, while the earlier or constant current type is rated for automatic welding continuously at 70 per cent of full load. Thus while it can be used at full load for hand welding and overloaded for short periods, its output for automatic application is limited to 70 per cent.

The future trend is undoubtedly towards increased use of automatic welding, and hence of the constant potential generator. As yet, however, Lincoln's turnover is small compared with the constant current type since there are so many applications of welding, particularly on sites, where hand welding using coated electrodes is the only practicable means. The versatility of the constant current machine will ensure its continuing popularity for some time to come, since it can cover such a wide variety of applications.

Triumph Herald—13 per cent More Power

By Gordon Wilkins

When the Triumph Herald originally came out, it had a great many features to attract buyers who were looking for a new practical small car —a chassis which needed no regular greasing, separate chassis with detachable body panels for easy repair, all-independent suspension, 25 ft diameter turning circle, crisp Italian styling by Michelotti and unrivalled engine accessibility. But on performance it was quickly challenged by the four-speed Dauphine and the BMC Mini-Minor, both selling at a lower price. An early step in giving it more urge was to offer a twin-carburettor engine of the coupé and convertible as an option on the sedan. But Standard Triumph were meanwhile working on the long-term answer and have now come up with a larger engine known as the 1200, shown in Fig. 1, which becomes standard equipment in all three models.

By respacing the bores in the block it has been possible to increase them to 69·3 mm (2·728 in) diameter which, with stroke of 76 mm (2·992 in) gives a capacity of 1,147 cc (70 cu. in). With a compression ratio of 8 to 1 and a single carburettor, this engine delivers 39 bhp net (45 bhp SAE) at 4,500 rpm.

Engine size has been increased by 21 per cent over the old 948 cc engine, without increasing the outside dimensions. Power has gone up by only 13 per cent because the same valves and valve gear are retained from the previous unit (which gave 34½ bhp installed) but this feature had the effect of producing a big increase in torque in the middle speed range where it is of most use to the average driver. In fact the maximum torque is now 60·9 lb-ft at 2,250 rpm, against the previous 48 lb-ft, and 2,750 rpm—an increase of 27 per cent and a reduction of 500 rpm in the speed necessary to achieve it.

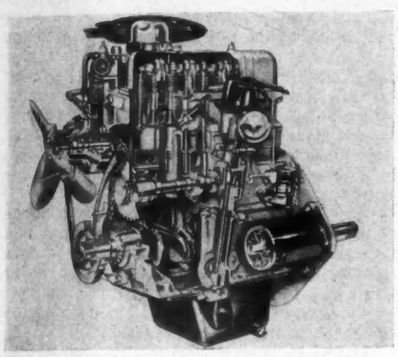


Fig. 1 By respacing the bores and increasing their diameter the capacity of the new 1200 Herald engine has been increased by 21 per cent.

This improvement is translated into much improved top-gear performance besides a useful gain in through-the-gears acceleration and it has been possible to change the axle ratio to 4·11 to 1. According to Standard Triumph International, time from 10 to 30 mph in top is now about 11·7 seconds as against 15 seconds, and time from 30 to 50 in top is cut by over 3 seconds. Through the gears STI claim the 1,200 goes from zero to 50 mph in 17 seconds (against 20 seconds) and 0 to 60 in 27·4 (against 30·4).

Comparing the new unit with the twin-carburettor engine, it is claimed that the ability to produce acceleration at lower engine revolutions means extra performance with very little increase in fuel consumption. Repositioning of the cylinder bores has required a new crankshaft and connecting rods. It has also reduced the width of big-end bearings but this change is compensated by using highly resistant lead-indium bearing shells.

Visible changes to the Herald may be observed in Fig. 2; they are chromium strip round windshield and rear window and at the base of rear quarter windows. White rubber bumpers are now fitted for all markets and the name Herald is now on the bonnet. The instrument panel, illustrated in Fig. 3, is in polished walnut and has a lockable glove box and the instruments are in black with white lettering. There are darker, more practical colours for carpets and there are new wider, more deeply upholstered front seats. There is also a pull-up handbrake of improved design between the front seats.

The Herald 1200 is being built in the new £2½ million assembly hall at the Canley, Coventry, works of STI. This is claimed to be the most highly mechanised assembly plant in the European industry. It is 1,000 ft long, with three assembly lines and can turn out a quarter of a million vehicles a year.

Fig. 2 Visible changes in the new Herald include chromium strip round the windshield and rear window and white rubber bumpers.

Fig. 3 The instrument panel is in polished walnut with a lockable glove box.

At the end of each assembly line each car is run on rollers to check functioning of the mechanical parts and then goes through a water spray booth which tests it for leaks. Special attention is given to final finish and inspection; so much so that STI have told their British dealers they need no longer do pre-delivery checks. STI undertake that the car is ready for delivery to the customer when it leaves the factory; in fact they are now offering facilities for customers who wish to collect their own new cars.

Aerostable Suspension Uses Neoprene

Neoprene is employed in the aerostable suspension system fitted to the Renault Dauphine and has recently been tested under rigorous conditions, including four years field testing.

Tests were carried out on the new Dauphine in French Guinea, where the company has a research centre. This country was chosen because it has one of the hardest climates in the world, combining high temperatures with high humidity and big changes in conditions from night to day. Neoprene in the cars' aerostable suspensions stood up well to extended trials in these and also arctic conditions.

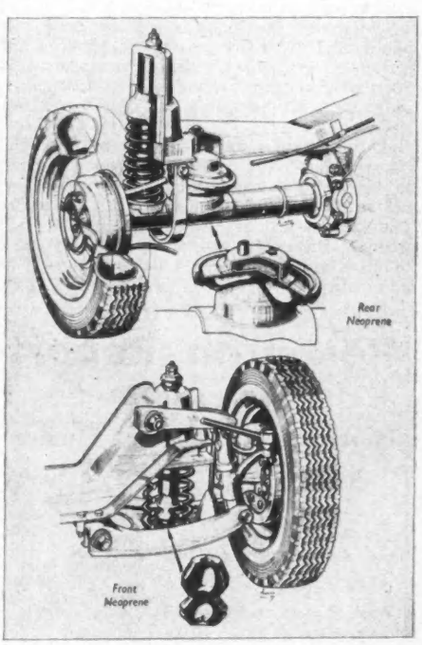
The aerostable suspension is a novel system of springing introduced by Régie National des Usines Renault, of Billancourt, Seine, France. The system is now incorporated in the rear suspensions of their Dauphine, Dauphine-Gordini and Floride models.

It is traditional for cars to have leaf spring suspension which, although effective, may in some cases be too hard for comfort when there is only one person in the car. Rubber suspension, on the other hand, is not sufficient for a full load of passengers. The aerostable system embodies the advantages of both these methods with a neoprene air cushion and steel springs. As a result, when the load of the car increases, the springs take up the additional weight, so ensuring a comfortable ride however many passengers there may be.

The front and rear suspension units of the new Renault Dauphine are shown in the illustration, which indicates the position of the Neoprene air cushions. The use of Neoprene was recommended on the grounds of its good ageing properties, excellent air retention, oil and abrasion resistance, and good flexing properties.

For four years the aerostable system incorporating the Neoprene air cushion was tested by Renault engineers in the field. Test cars were driven in the arctic regions of Canada and Norway, in the highly abrasive conditions of the Sahara desert and in humid, tropical French Guinea. "During this period," reports Mr. P. d'Arrivere, a manager in Renault's materials testing and research department, "we did not experience one breakage or cracking of the Neoprene air cushions."

According to the makers, the Neoprene cushion will last the life of the motor car and needs no maintenance. Neoprene is produced as a raw material by the Du Pont Company in the United States and in their new plant at Maydown, Northern Ireland.



Front and rear suspension units of the Renault Dauphine, showing the Neoprene air cushions.

Hovercraft Can Fill the Transport Gap

Hovercraft Development Limited began two years ago. Their main aim is to develop and improve hovercraft systems. Though engaged on practical problems, they are looking ahead to transatlantic possibilities.

WHEN considering the size-speed relationship for present-day commercial sea and air craft, it is apparent that there is a large gap from about 30 knots to 100 or more knots in the speed range. Furthermore, there is a very great difference in maximum size between the ships, at the bottom end of the speed range, and the aircraft at the other end. It is believed that the hovercraft will someday fill these gaps.

In terms of specific power, in the range from about 30 knots to about 300 knots, there are no efficient sea or air vehicles. Similarly, with overland vehicles, there is a gap from the present upper limit of 100 knots to about 350 knots which is the lower limit of a really efficient aircraft.

The well known Saunders-Roe SRN 1 is by no means the only conception of hovercraft design. In fact, the area between ships and aircraft may eventually be filled by quite a large variety of hovercraft, of widely varying designs. The final form will depend upon the interplay of three main variables: speed, size, and the roughness of the surface over which it must travel.

The table lists a number of applications for craft between 15 and 400 knots and from 2 tons to 10,000 tons, which can operate on any surface from a smooth prepared track to the open sea. This is an enormous field, and each of the many operating techniques, e.g. water jets, air jets, sidewalls, flat bottoms, open jets and recirculation jets, may have a place.

Undersurface Configurations

There are various ways of designing the undersurface of a hovercraft and some of the most important of these are set out diagrammatically in Fig. 1. The first possibility is a parallel-sided water craft with the cushion contained by a water or air curtain system fore and aft, and by solid "sidewalls" at the sides. It is thought that this arrangement is suitable for slow speed craft in the speed range 15 to 40 knots.

The second possibility is a water craft with minor land capability, having air jets fore and aft, and air jets at the bottom of shorter sidewalls. Such an arrangement would seem to be attractive in the 60 to 100 knot area, and up to quite large sizes.

A third arrangement, the flat or near flat-bottom craft with curtains all round appears to be the best basic design both above and below 100 knots. However, it can be argued that a flat-bottom design is fundamentally wrong. Since there will always be some degree of pitch and roll, even in the presence of an automatic anti-roll system, and since the craft is bound to make contact with the surface from time to time, there is a good argument for at least some degree of shaping.

The three diagrams on the right hand side of Fig. 1 illustrate what are called "flexible hovercraft." At Hovercraft Development Limited, it is believed that many ground effect vehicles in the future will be based on these lines.

Such flexible systems may be classified under three headings: (1) contact-actuated, for slow speed work, (2) pressure-actuated, for intermediate speed work, and (3) power operated and servo-actuated, in the high speed category.

Looking into the far distant future, a 10,000 ton open water hovercraft may require, in stiff form, about half million h.p. for lift. However with a suitable power operated flexible skirt, it is estimated that the power requirement would be about 1/6 of a million hp. Such a saving would clearly warrant a considerable amount of technical complication and development.

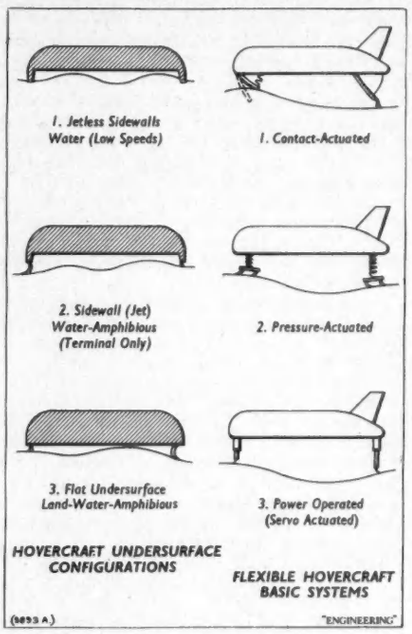


Fig. 1 Hovercraft systems and configurations.

Jet Systems

Three basic types of jet system are shown in Fig. 2. The top one is a simple annular curtain system which is now well known. The second one, which is called open recirculation, shows a power saving in relation to the simple jet. In this system, most of the air at design height travels inwards and downwards, it is then bent round by the developed cushion pressure, and enters a pick-up port, finally being exhausted as a secondary open jet outside the primary jet. Such a system is somewhat difficult to engineer, but has the merit of being easy to design aerodynamically. It also produces considerably less spray than an open jet, for a given cushion pressure and height, and presents a worthwhile saving in power.

The third and fourth systems depict inward and outward collection, closed vortex, recirculation systems, which were first demonstrated in the autumn of 1956. A considerable amount of work has been done on these systems at Hovercraft Development Limited, and satisfactory results have been obtained in the laboratory. Such systems require empirical design due to the lack of theoretical understanding of the complicated problems involved.

Fig. 3 shows the performance of these three basic jet systems expressed in terms of fan hp per square foot of curtain (assuming no duct loss) at a cushion pressure of 100 lb per sq. ft, plotted against various values of height-to-primary jet width (h/t ratio).

In considering the various jet techniques, it should be noted that the recirculation systems use up quite a lot of the plan area of the craft, necessitating a higher cushion pressure than will be required for an open jet design of the same craft area and weight. This leads to an optimum jet system for any given value of diameter to hover-height ratio.

Another important factor, which is not brought out in the curves, is the power required to overcome the momentum drag of the lift air, and this point is illustrated in Fig. 4. Here the power per sq. ft of curtain at optimum h/t ratio is plotted against speed for the three systems at two cushion pressures of 100 and 25 lb per sq. ft; and the rise in power with craft speed will be noted. Again this effect is somewhat masked in practice, due to a significant amount of aerodynamic lift at 100 knots. Further development is expected to show an improvement of these power requirements.

Sidewall or Curtain?

It can be shown that at 100 knots a jetless sidewall craft would not be the optimum design, but that at low speeds sidewalls are more economical than air curtains. For a mixed system of sidewall with jets at the bottom, to arrive at an optimum design, one must know the sea state and attempt to calculate the mean wetted area for various ratios of curtain height to sidewall depth. Such a design would then not be optimum for a different sea state.

One of the main arguments in favour of sidewalls with jets in the higher speed range is the desirability of increased body clearance for water craft faced with operation over a random element. Craft may be controlled in pitch, roll and heave, provided the body of the craft can be kept out of contact with "green" water.

Although the wave drag of a properly designed hovercraft at cruising speed only accounts for a small part of the cruise power, in general, craft

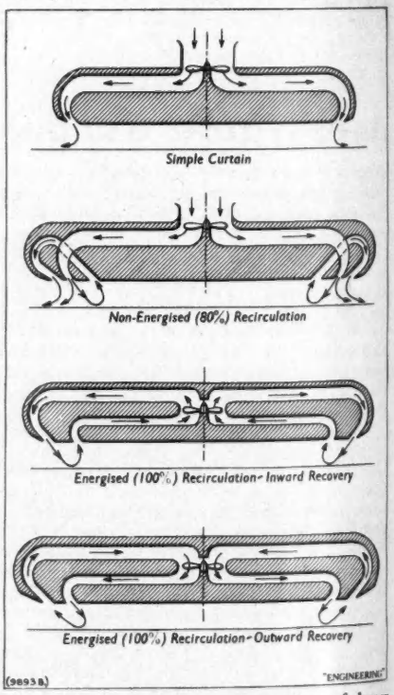


Fig. 2 Diagrammatic representation of hovercraft jet systems.

Research Report

on the work of

Hovercraft Development Limited, St. John's Street, Hythe, Southampton

Technical Director
C. S. COCKERELL, M.A.(Cantab)

Chief Engineer
W. A. PENNINGTON, B.Eng., F.R.Ae.S.

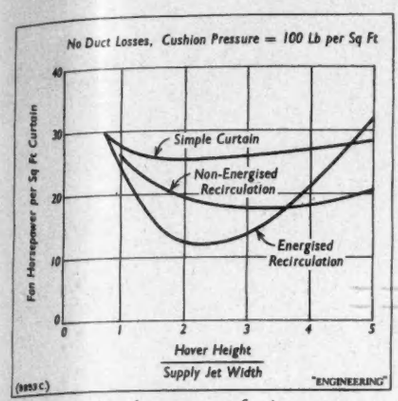

No Duct Losses, Cushion Pressure = 100 Lb per Sq Ft
Fan Horsepower per Sq Ft Curtain
Simple Curtain
Non-Energised Recirculation
Energised Recirculation
Hover Height / Supply Jet Width
"ENGINEERING"

Fig. 3 Fan horse-power for jet systems.

should not be operated in deep water within the speed range $1{\cdot}3\sqrt{\text{length}}$ to $3{\cdot}6\sqrt{\text{length}}$ in knots. For example, a 1,000 tons channel ferry with a length of about 300 ft should be operated either below 23 knots or above 63 knots. This problem is very much more complicated for craft operating over shallow water, especially if such craft are designed to operate in a below-hump regime.

Performance over Waves

Although man has been building and using displacement ships for thousands of years, hull design and rough weather performance are still largely empirical, and cannot be set down in the form of a neat mathematical expression. However, it *can* be logically argued that existing ship forms with hard bottoms would not be capable of operation over rough seas at 100 knots—however much power may be available.

However, the hovercraft is not governed by the same rules—its medium is a self-made, almost inertialess, cushion of air. It is this air cushion suspension which makes it possible to contemplate the passage of a craft of 1,000 tons, or more, over rough seas at speeds of the order of 100 knots. The minimum thickness of the cushion, and therefore the lift power required, is a function of the sea state which the craft will have to meet.

Fig. 5 indicates some of the problems of rough water operation. The two hatched lines give the relationship of the height of sea waves, measured from trough to crest, to their wave length. Assume that a hovercraft of approaching-zero length is attempting to follow these waves. (Lines of constant maximum vertical acceleration are also shown, for which purpose the sea waves are idealized sine waves, and the path of the craft is also assumed to be sine wave in phase with the sea wave. It will be seen that a craft of approaching-zero length travelling at 100 knots would only be capable of a heave amplitude of 1 ft, if it were permitted accelerations of 1 *g* in heave when travelling over seas of 100 ft wave length. However, waves 1,000 ft long, even with a maximum amplitude of 35 ft, could be followed with accelerations in heave of less than 1 *g*. Accelerations of 1 *g* are, in fact, uncomfortably high, and a more realistic value would be 0·25 *g*.

The performance of the craft over waves depends to a considerable extent upon the jet configuration, and the method of feeding the jets. But, in general, the craft when travelling at speed will clear waves with an amplitude of about twice the flat surface hoverheight, and of a wave-length less than the length of the craft. If the maximum probable wave heights of Fig. 5 are to be cleared, a 100 ft craft must have a flat surface hover-height of 5 ft; a 200 ft craft must have 7·5 ft; and a 400 ft. craft a clearance of 11 ft, and so one, to clear all waves of less than the craft length. For waves which are longer than the length of the craft, and if accelerations in heave are to be limited to 0·25 *g* at 100 knots, craft of any length up to about 400 to 600 ft must have a body clearance of at least 11 ft.

TABLE:—*Hovercraft Applications.*

Class		Application	Cruising speed, knots	Weight range, tons
Water only	1	River craft (below hump speed) ..	15–30	100–1,000
	2	Open water craft with jetless sidewalls (below hump speed) ..	20–40	2,000–10,000
Amphibious	1	River, sheltered water or channel ferries	50–120	100–1,000
	2	Open water craft ..	100–120	2,000–10,000
	3	Open water craft with mixed lift	120–200	5,000–10,000
Land	1	Special land craft—open country ..	50–70	2–20
	2	Land freighter—unsurfaced prepared track	30–70	50–200
	3	Tracked hovercar—concrete track ..	150–400	20–200
Aircraft	1	Aircraft with hovercraft landing system	200 upwards	100 upwards

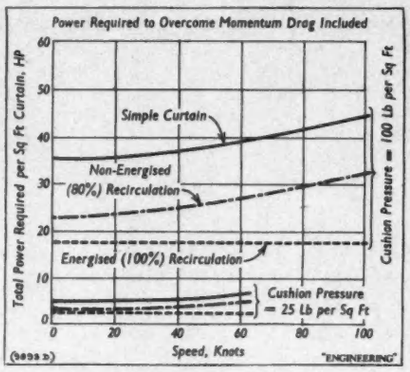

Power Required to Overcome Momentum Drag Included
Total Power Required per Sq Ft Curtain, HP
Cushion Pressure = 100 Lb per Sq Ft
Simple Curtain
Non-Energised (80%) Recirculation
Energised (100%) Recirculation
Cushion Pressure = 25 Lb per Sq Ft
Speed, Knots
"ENGINEERING"

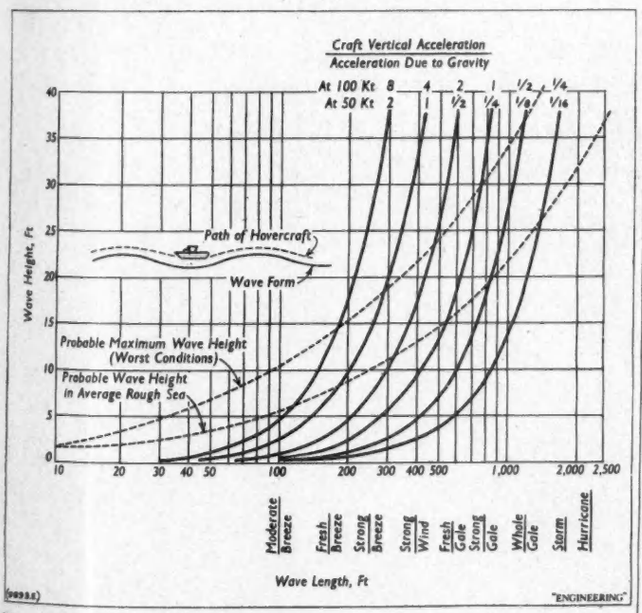
Fig. 4 Total power required for lift.

Consider a power-operated flexible hovercraft at 100 knots, wherein the flexible skirt is capable of acceleration in heave of 8 *g*. The flat surface clearance of the power operated skirt would then only have to be about 3 ft for the craft to be capable of negotiating any sea, up to the worst possible conditions set out in Fig. 5. If the skirt were capable of operation at 4 *g* (a more realistic figure), the clearance would have to increase from 3 to 4 ft. Consideration would have to be given to the vertical fronts of breaking waves.

The case of flexible hovercraft may be summed up by saying that heave accelerations greater than 0·25 *g* are not acceptable for the body of the craft, but accelerations of 4 to 8 *g* would be acceptable for the flexible skirt of a flexible hovercraft. Such a system, if and when it can be engineered, would give a large hovercraft a rough-water performance as good as that of large ships or large aircraft. Over land, it would yield a vehicle competitive with any ordinary commercial motor vehicle.

The position has now been reached wherein it is possible to compile a tentative table setting out the speed brackets for the various possible craft configurations, see Fig. 6. Most of the work to date, and most of the craft constructed, have been in the flat-bottom class, so that we are now in the top left hand corner of the diagram.

A lecture on future developments in hovercraft was delivered by Mr. C. S. Cockerell at the Sorbonne, France, on 27 March. Many of the above ideas and illustrations were pesented on that occasion.



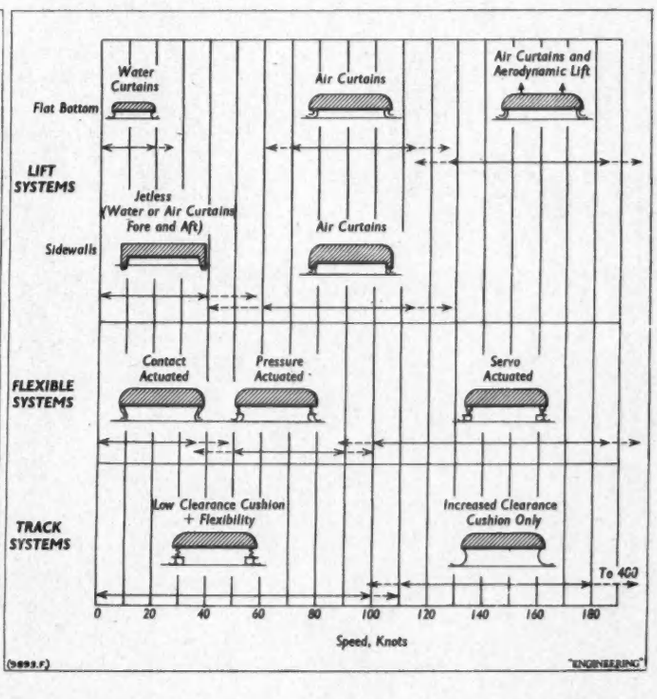


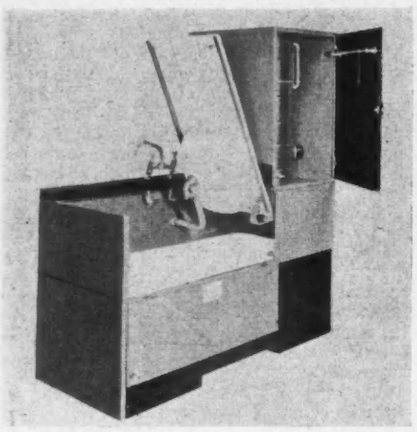
Fig. 5 (Above) Vertical acceleration in heave over waves (idealized).

Fig. 6 (Right) Present-day and possible future hovercraft systems.

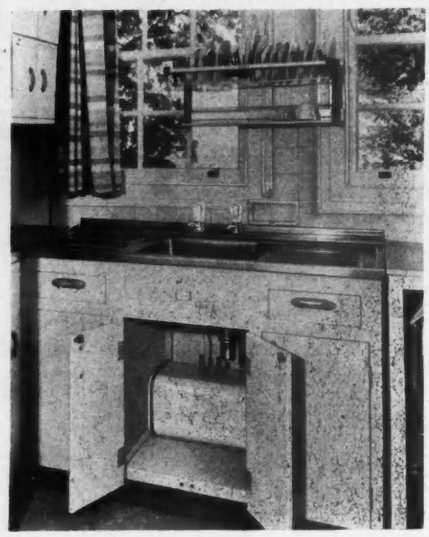
More Space Savers

THERE have been several attempts in the past to accommodate a bath in a house not originally designed with one, by installing it in the kitchen. Some were definitely " home made " efforts, the bath being simply covered in by a board when not in use. The amount of stuff that could accumulate on the board before the bath was wanted as a bath was truly remarkable. A planned solution to the problem is the " Bink " shown in the first illustration, a combined bath and sink unit made by Bink Unit Developments Limited, Rowland Street, Oldham, Lancashire. The unit also contains a built-in water heater and tank.

The illustration shows the Bink in the halfway position. The combined sink and draining board, which is a single Perspex moulding, is partly raised, and the side panel giving access to the bath has been let down. In this model the taps are placed centrally along one side; they can also be supplied mounted at the end, in which case the sink is on the left. The bath, also made in Perspex, is 5 ft long. Bath and sink are available in a choice of colours.



(*Above*) *The Bink provides a solution of the bath-in-the-kitchen. It has its own hot water supply.*



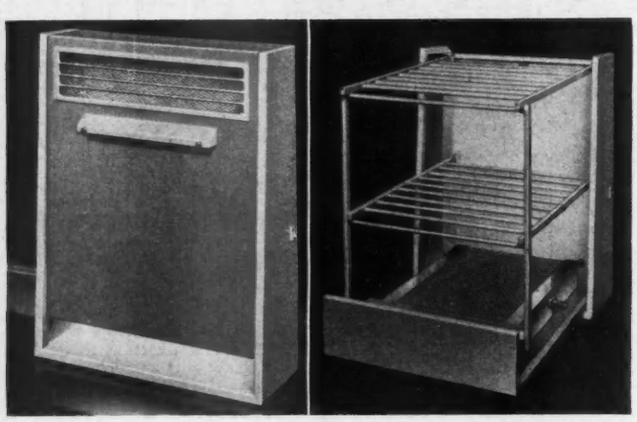
(*Right*) *Fitted under the sink, the Sto-a-way water heater has a capacity of 2 gallons.*

The main frame of the unit is made of Stelvetite—plastic coated steel—and can also be in a choice of colours. The hot water cylinder has a capacity of 15 gallons (or 25 gallons as desired) and is fitted with an immersion heater. The complete unit requires a floor space of 5 ft 6 in by 2 ft and stands 6 ft high to the top of the tank compartment. An alternative version is fitted with a Vanitory basin and dressing table in lieu of the sink and draining board.

The second illustration shows the Sto-a-way sink water heater that is designed by the General Electric Company to fit in a cupboard below the sink where it will neither restrict headroom nor obstruct the view. It has a capacity of 2 gallons and can have either a 2 or 3 kW element. The thermostat is adjustable from 100° F to 180° F. The required temperature can be set during installation—a value of 140° F is recommended for use in hard water areas. The inner tank is fully lagged with resin bonded glass fibre and aluminium foil so that heat losses are kept to a minimum.

The heater can be fed in several ways: from a ball valve tank to supply two or three taps; from mains or ball valve tanks to feed a single outlet; or to feed spray taps for quick hand washing. In addition, a single point self-venting tap which eliminates the need for cisterns or vent pipes can be used. The tap has been designed to fit standard sink and basin holes without modification. A matching cold tap can be supplied for the sake of appearance.

The last illustration is of the Straightaway convector-drier made by Barber Electrical Services Limited, The Airport, Weston-super-Mare, Somerset. Closed, it is a normal free standing convector heater measuring 24 in wide by 30¾ in high and 8¼ in deep. The front panel opens forward to produce two drying racks with a total length equivalent to a 30 ft clothes line. The depth when open is 28⅜ in. The whole unit is mounted on castors so that it can easily be moved from room to room. A control switch on the element offers a selection of 1 or 2 kW loading and a pilot light gives indication that the unit is connected to the mains. Models are available for both 200-220 and 230-250 volt supplies.



A clothes drier and airer is combined with a convector heater in the Straightaway unit. The lower rack can be folded away if larger articles are to be dried. There is a choice of two heats, either 1 or 2 kW according to requirements.

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